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FOREST OPERATIONS AT SUKNA, KURSEONG DIVISION, BENGAL, BY E. O. SHEBBEARE, I.F.S., AND G. W. HOULDING, FOREST ENGINEER.

(Conclusion.)

PART II.—ARTIFICIAL REGENERATION.

The work at Sukna consists in clear felling a piece of forest each year and re-stocking it by sowing or planting trees among field-crops, the object of which is to keep the ground clear. This is what is known as *taungya* working and such work is going on in most of the Reserved Forests in Bengal now, having replaced the Selection and Coppice systems during the last five years.* (The Selection system means taking out mature trees as they occur, scattered through the forest and the Coppice system means clear felling the forest and allowing it to send up coppice shoots).

The difference between the working at Sukna and in most other Bengal *taungyas* is that, here, both the extraction and the growing of field-crops are done departmentally—the extraction being mechanical. The reason for departmental working instead of the extraction of standing trees by purchasers and the cultivation of field-crops by villagers is partly necessity and partly experimental, the demand for forest produce as well as the demand for dry cultivation being poor. At the same time it is important to find out how far departmental working is practicable as there are other forests in Bengal very little better off for purchasers or villagers. With regard to mechanical extraction it seems possible

* The reason for this change is explained in Appendix IV.

that, now that the selection of a tree here and there has given place to clear fellings, mechanical extraction on more or less American lines may prove more profitable than hand sawyers and bullock-carts.

Extraction.—The chief difference between conditions here and in America lies in the smallness of the areas to be worked, and the reason why we have to work a number of small areas rather than one big one lies in the fact that, here, quite a considerable amount of the produce is firewood, which cannot bear the cost of long distance transport and, even if it could, local demand (especially tea-garden demand) has to be considered. Thus, concentration not being practicable, it is important to find out how small an area can profitably be worked mechanically and for this reason, the plant is on the smallest and cheapest scale possible.

The extraction plant consists of a railway siding, a saw-mill and a skidder and the method of extraction is as follows. Sal (the biggest revenue producer) is extracted by skidder and rail to a sale depôt at Siliguri in the largest logs possible, smaller sal is sold as poles or as pieces for making ploughs, rice-pounders, etc. Almost all other species are sawn in the mill into ½ inch planking for tea-chests and the branchwood, both of the sal and of the other trees is cut into firewood and sent by rail to tea-gardens in the neighbourhood of Kurseong.

Comparison of Profits from Departmental working with Sale of standing trees.—The yield of each of the above kinds of produce to the acre is roughly as follows:—

		Sal Forest.	Mixed Forest.
Sal logs	...	1,000 cubic feet.	Nil.
Sal poles, etc.	...	121 cubic feet.	Nil.
Soft-wood	...	118 cubic feet.	177 cubic feet.
Firewood	...	4,050 stacked c. ft.	3,600 stacked c.ft.

It is interesting to compare the price realised by each kind of produce when sold as standing trees with that realised by departmental working after deducting the cost of extraction. It should be remembered, however, that, in a place like Sukna, if sale to

purchasers alone were relied on, a good deal of the produce other than sal would not be sold at all.

Price realised. Rs. per acre.		Cost of working. Rs. per acre.	Nett profit. Rs. per acre.	Value sold standing. Rs. per acre	REMARKS.
Sal Forest.					
Sal logs ...	1,350	203	1,156	662	Appendix I.
Sal poles ...	30	Nil	30	...	
Box-planking ...	58	29	29	22	Appendix II.
Firewood ...	175	77	98	61	Appendix III.
Total ...	1,622	309	1,313	745	
Mixed Forest.					
Box-planking ...	87	43	44	33	Appendix II.
Firewood ...	152	68	84	36	Appendix III.
Total ...	233	111	128	69	

It is not suggested that departmental working is always more profitable than sale standing as, elsewhere, better prices may be obtained from purchasers.

Departmental crops.—As mentioned above, the *taungya* crops in most other places belong to the villagers who are given the land rent free in return for planting or sowing it up with the forest crop. With good villagers, such as the Garo villagers in Buxa Division, a successful crop of sal can be established for about Rs. 10 per acre, this being the cost of tending the crop after its second rains from which time the villagers are no longer responsible for the plantation and must be paid for any work they do. These villagers, however, are given a certain amount of wet paddy land free for permanent cultivation the rental on which ought, perhaps, to be included in cost of *taungya* plantations made by them.

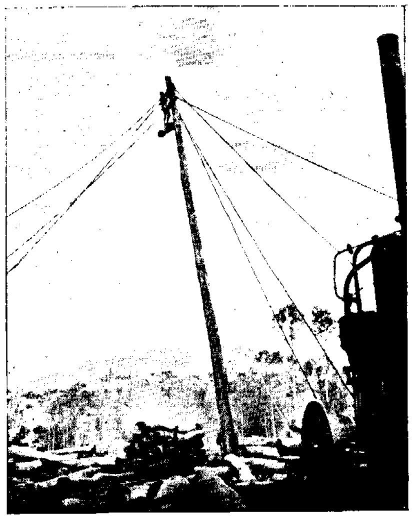
Where such villagers are not available two alternatives are open to us (1) to keep the young plants clean by paid labour without crops or (2) to grow crops by paid labour and try to

recover the cost by the sale of the crops. The first of these alternatives is being tried at Rajabhatkhawa (Buxa Division) and sal crops can be established at a cost of about Rs. 40 per acre (Appendix IV).

The second alternative, departmental field-crop, is what we are trying here at Sukna. If departmental crops were always a success, this method would be the cheapest of all, in fact it would show a profit. Unfortunately, not being farmers, we have made almost every possible mistake at various times, in spite of the very valuable assistance we have had from the Agricultural Department, with the result that we cannot point to any large area over which we have made our crops pay for the cost of cultivation. For this reason the figures showing the expenditure and receipts under this method of working (Appendix V) may be regarded as artificial to some extent because they show what should have happened (and did happen over certain areas and in certain years) rather than what actually happened in any one fair sized plantation from the start to the time the plants were established. At any rate, for what they are worth, these figures show a profit of about Rs. 20 per acre, enough to pay for the fencing of area with a little to spare. It is to be hoped that, as we have so far not repeated a mistake once made, that we soon exhaust all possible errors and begin to be successful.

Possibilities of Mechanical Ploughing.—Shortage of labour is the greatest difficulty we have to contend with and, as far as extraction is concerned, everything that can be done has been done to eliminate it, but, when it comes to the cultivation of crops, we are still where we were and it is here that the shortage of labour is felt most keenly.

The solution would appear to be to save labour by the use of a cable plough. In the skidder we have a source of power which lies idle once the logging and loading work is finished, and with an efficient machine, such as we hope soon to have, this work should be finished by the end of February, just about the time when ploughing ought to begin. We propose to experiment with a cultivator having spring tynes capable of giving way before large stumps, and with a two-drum skidder it should be possible

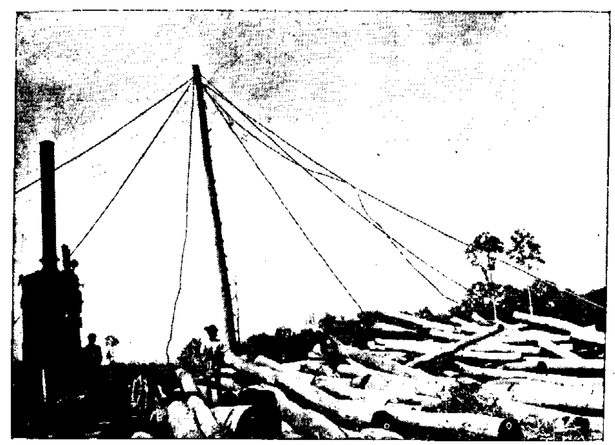


1. Above, a man oiling the head pulley block, at the top of gin-pole. Below, a loaded log-car.

2. A dump of skidded logs, seen from the top of gin-pole.

Photo.-Mechl. Dept., Thomason College, Roorkee.

3. View of the area skidded over.



Photos by G. W. Houlding.

4. General view of the skidder and dump.

to pull such an implement backwards and forwards over the ground in parallel furrows.

Fencing.—The cost of fencing has not been included in our figures because, although it is an expensive item, the price of wire has come down considerably lately. It is estimated that with an annual coupe of 50 acres, and fencing maintained round each coupe for 3 years, the cost would not be much over Rs. 12 to 15 per acre, if the life of the wire is 10 years, with 3 moves in that time.

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Forest Engineer.

APPENDIX I.

Average number of Sal trees per acre (over 3 feet girth) in the forest near Sukna. Also outturn and estimated value worked departmentally and sold standing.

Girth.	Trees per acre.	Volume per tree (Cubic foot).	Volume per acre (Cubic foot).	Siliguri price per cubic foot.	Extraction to Siliguri.	Profit per cubic foot, Departmental.	Profit per acre, Departmental.	Estd. price per tree sold standing.	Price per acre sold standing.
	A	B	C	D	E	F	G	H	J
				ANNAS.			RUPEES.		
3 to 4 ft. ...	6·76	21	141	9	5	4	35	7	47½
4 to 5 ft. ...	7·54	35	264	14	5	9	148½	13	97
5 to 6 ft. ...	7·15	47	336	25½	5	20½	430½	28	200
6 to 7 ft. ...	3·44	80	275	28	5	23	395	80	275
Over 7 ft. ...	·53	100	53	28½	5	23½	147	80	42½
Total ...	25 42		1,030				1,156		662

Data on which the above figures are based.

COLUMN A.—Average of this year's area (34 acres). For check see note on Column C below.

COLUMN B.—From Mr. Glasson's figures for Quality I Sal in Jalpaiguri and Buxa divisions.

COLUMN C.—From A & B. The average outturn from these coupes for the past five years has worked out at almost exactly 1,000 cubic feet per acre which, to some extent, checks these figures.

COLUMN D.—From figures worked out by the Imperial Silviculturist from details supplied him of all sales in the 1920 area (46 acres).

		Rs.	a.	p.
COLUMN E.—Felling, logging and dressing	...	0	1	0
Skidding and loading	...	0	1	0
Freight to Siliguri (average)	...	0	2	4
Unloading ...	...	0	0	5
Total	...	0	4	9
	say	0	5	0

COLUMN F.—From D and E.

COLUMN G.—From F and C.

COLUMN H.—From prices realised in auction for an adjoining clear-felled area. The prices were somewhat higher than those realised for selection lots as might be expected. The proportion between the girth classes was taken from figures used throughout Northern Bengal for estimating the value of auction lots.

COLUMN J.—From H and A.

Average Yield of Sal under 3 ft. girth per acre.

Total...4,102 c.ft. poles @ Re. 0-4-0 per c.ft. = Rs. 1,025-8-0
Per acre. 121 " " " " " " = " 30-4-0

Note.—A large amount of small pieces from tops of trees, etc., were sold for making ploughs, rice pounders, fencing poles, etc. These have been included in the girth table above but the following details are interesting :—

					Rs.	a.
Rice pounders.	697 pieces =	1,459 c.ft.	@ Re. 0-4-0 each =		174	4
Ploughs ...	4,114 „	4,114 „	„ 0-2-0 „		514	4
Fencing posts	534 „	265 „	„ 0-3-0 „		100	2
Total ...		5,838			788	10
Per acre ...		171			23	3

APPENDIX II.

Average yield per acre of box-planking and comparison between returns from departmental working (with sawmill) and sale of standing trees.

	Yield per acre in log.	Yield per acre, planking.	Value of planking per acre.	Cost of sawing, etc., per acre.	Returns by departmental selling per acre.	Return per acre sold standing.
	A	B	C	D	E	F
	C.ft.	S.ft.	Rs.	Rs.	Rs.	Rs.
Sal Forest ...	118	1,416	58	29	29	22
Mixed „ ...	177	2,124	87	43	44	33

A = actuals of this year's work.

B = allowing 50% wastage in sawing.

C = average sale price 41 % s.ft.

D = see Part I, cost of sawing.

E = from C & D.

F = Col. A and average royalty of as. 3 per c.ft.

APPENDIX III.

Average yield per acre of fuel and comparison between departmental working and sale of standing trees.

	Stacked c.f.t. per acre.	Price realised per acre.	Cost of extraction per acre.	Nett profit per acre.	Value sold standing per acre.
		Rs.	Rs.	Rs.	Rs.
Sal Forest ...	4,050	175	77	98	61
Mixed " ...	3,600	152	68	84	36

(For details of cost of extraction of fuel see Part I.)

APPENDIX IV.

Cost of Plantation at Rajabhatkhawa.

Omitting cost of fencing and staff.

(Figures given are chiefly for sal but apply generally to other species.)

	First Year.	Per acre. Rs. a. p.
February-March ...	Cleaning up felling area and burning ...	1 8 0
March	Hoeing 3 feet lines, 18 inches deep, 12 feet centre, for sal, or in case of other species 3 feet lines, 1 foot deep, 6 feet centre.	4 0 0
May and June ...	A light hoe over lines to break up soil just before sowing.	1 0 0
Do.	Seed 40 seers of sal (varies with good or bad seed years).	1 0 0
Do.	Sowing sal seed, triple rows 6 inches apart, 6 inches in rows.	1 0 0
June to September ...	Weeding 3 times at Rs. 2-8-0	7 8 0
October	A final weeding. (A light hoe would probably be beneficial at this time but has not been done).	2 8 0
	Second Year.	
March	Clearing creepers	2 0 0
May to October ...	Four weedings at Rs. 2-8-0 each	10 0 0
	Third Year.	
March	Clearing creepers	2 0 0
May to October ...	Two weedings at Rs. 2	4 0 0
	Fourth Year.	
Rains	Cleaning	3 0 0
	Total ...	39 8 0

Note.—With species other than sal the extra expense of nursery work is probably more than made up by increased growth and reducing weeding and cleaning necessary.

APPENDIX V.

Cost of taungya plantations made departmentally.
Panchenai Block, Kurseong Division (Estimated).

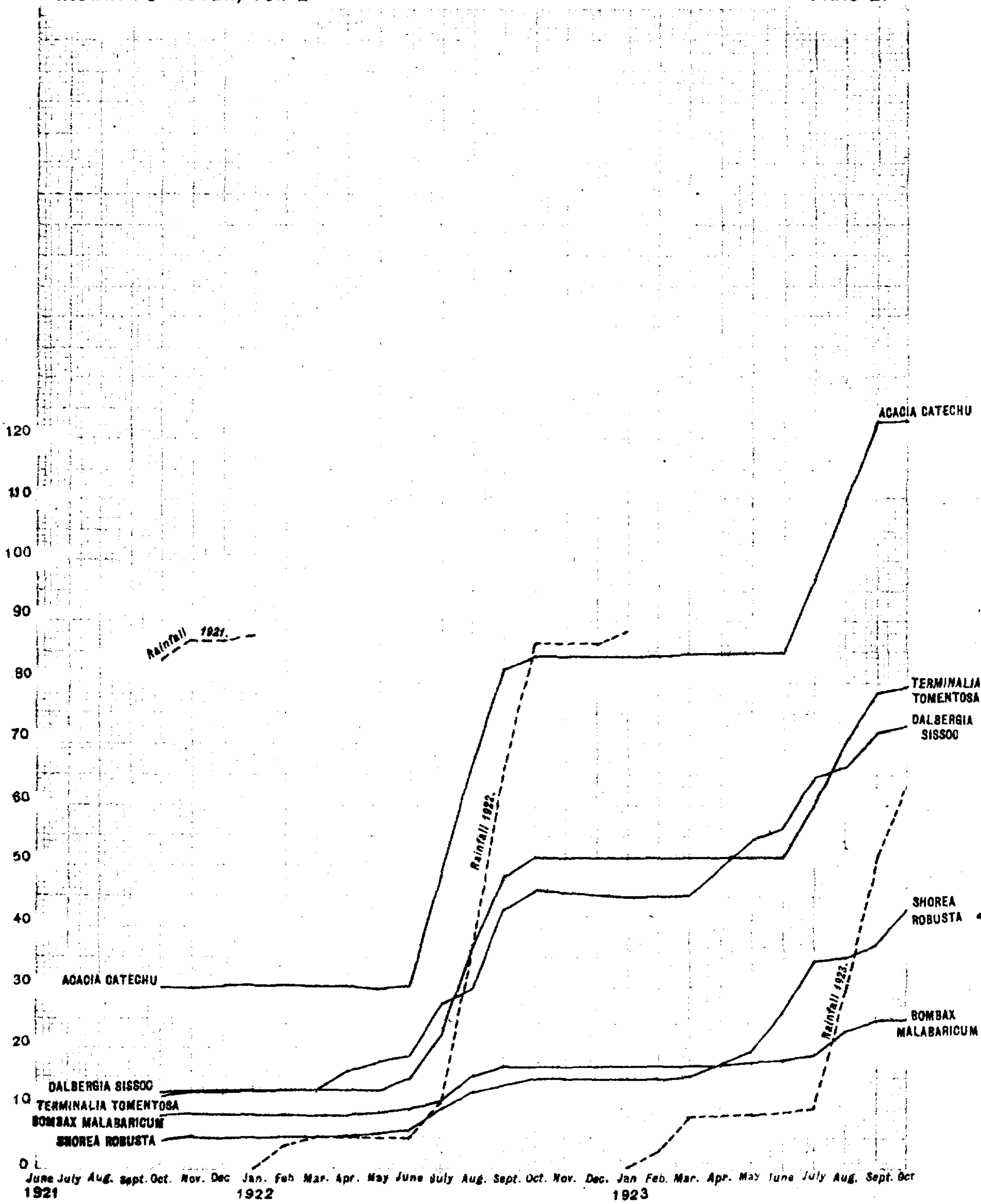
	FIRST YEAR.	Per acre.
		Rs. a. p.
February-March ...	Cleaning up felling area and burning ...	1 8 0
March-April ..	Hoeing	10 0 0
April	Cost of jute seed, three seers	1 2 0
Do	Sowing jute	0 11 0
May-June ..	Collected sal seed (the cost would be up to Rs. 7-8-0 in a bad seed year).	2 0 0
Do.	Smoothing lines for sowing sal seed and sowing seed in triple rows in lines 6 feet apart.	5 0 0
September ...	Thinning out jute and extracting fibre ...	10 0 0
October-November ...	Collecting jute seed (two maunds) ...	7 8 0
November ...	Weeding sal in lines	4 0 0
Do.	Hoeing for mustard	4 0 0
Do.	Cost of mustard seed and sowing	2 0 0
January-February ...	Reaping and preparing mustard	3 8 0
	SECOND YEAR.	
March-April ...	Hoeing for maize	6 0 0
April	Sowing maize	2 4 0
Do.	Cost of seed (seven seers)	1 6 0
May	Banking and thinning maize	4 9 0
June	Second banking	3 0 0
July	Reaping and carriage of maize	10 0 0
Do.	Hoeing for beans (*dal*, pulses, etc.) ..	4 0 0
July—August ...	Sowing of beans and cost of seed	0 11 0
November-December	Collection of beans	3 8 0
	THIRD YEAR.	
	Cleaning sal	3 0 0
	FOURTH YEAR.	
	Cleaning sal	3 0 0
	Total ...	92 11 0
	RECEIPTS	
	Jute fibre from thinnings 1½ maunds at say Rs. 5	7 8 0
	Jute seed, 3½ maunds at Rs. 15	52 0 0
	Mustard	1 15 0
	Maize 6½ maunds at Rs. 7	45 8 0
	Beans	5 8 0
	Total ...	112 7 0

APPENDIX VI.

Reason for the change from Selection to taungya system of working.

1. The reason for introducing the *taungya* system was the unsatisfactory state of natural regeneration of all the more valuable species both in the plains and the hills, in the former probably due to conditions induced by successful fire protection. In the case of sal, not only are natural seedlings scarce and established saplings absent but even the pole stage is often wanting in forests in which the mature crop is mainly sal. Something had to be done, and the result of experiments, many of them on a considerable scale and extending over several years, led to the rejection successsively of intensive weeding, regulated burning and various methods of supplementing natural regeneration. in favour of clear-felling and restocking. Further experiment pointed to field-crops as the surest means of establishing the plants, a conclusion arrived at, curiously enough. by the Cinchona and Forest Department quite independently at about the same time.

2. The history of the idea of employing field-crops to establish forest crops (long-known under its Burmese name of *taungya*) goes back some way even in Northern Bengal, for an attempt to establish sal in grass-land in Jalpaiguri by this means between 1896 and 1899 remains, in part, a perfect success, and the failure of the other part appears to be due mainly to neglect and absence of incentive, for, at that time, the aim was to introduce sal where none existed and no anxiety was felt for natural reproduction in existing forests. *Taungya* plantations mostly of *tun* (*Cedrela spp.*) and *lampati* (*Duabanga sonneratioides*) were started in 1908 and the best of them are a great success. It was, however, Mr. Troup, after his visit to these forests in 1914, who first proposed *taungya* on a large scale as the only apparent means of regenerating sal and this, together with the success of the Cinchona Department's forest plantations, led to the extensive adoption of the system in Northern Bengal. It may be of interest to note that teak *taungyas* were made in Chittagong as long ago as 1870 though the idea was abandoned and not re-started until 1912.



120
110
100
90
80
70
60
50
40
30
20
10
0
ACACIA CATECHU
TERMINALIA TOMENTOSA
DALBERGIA SISSOO
SHOREA ROBUSTA
BOMBAX MALABARICUM
ACACIA CATECHU
DALBERGIA SISSOO
TERMINALIA TOMENTOSA
BOMBAX MALABARICUM
SHOREA ROBUSTA
Rainfall 1921.
Rainfall 1922.
Rainfall 1923.
June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct.
1921
1922
1923

HEIGHT GROWTH OF SEEDLINGS.

The results of the measurements of periodical height growth of seedlings were printed in the December number of the *Indian Forester* of 1922. That article showed the monthly rates of growth of certain species sown in May and June 1921 and measured monthly from October 1921. In each case the height was the average of ten plants of each species.

These seedlings have now been measured monthly for a further complete year so that all are now roughly 28 months old and have completed three growing seasons.

In the case of certain species the ten plants have been reduced from various causes. In such cases the averages from the start are based only on those which now survive. In the case of *Shorea robusta* and *Terminalia tomentosa* all ten still survive. One plant of *Dalbergia Sissoo* had its top killed in April 1922 and never recovered. This was probably drought. Four out of the ten plants of *Acacia Catechu* had to be rejected but of these four two were accidentally broken this year, and the other two had their tops completely dead by June 1923 when the rest began to sprout. These were probably killed by drought. Five of the *Bombax malabaricum* were rejected but this plant is interesting in that three of the five were written as dead in June 1921 but all revived and all were again written as dead in July 1923, but all revived.

This has happened repeatedly with *Bombax* here in many experiments. Plants apparently dead all the hot weather suddenly sprang into life in July—a common enough phenomenon in India but one worth noting in a connection such as this. Plantations of *Bombax* should never be judged in North India till the rains have broken.

The *Cedrela Toona* were all so badly attacked by the borer that the results from these were useless.

The following table shows the increase in height of the plants month by month during the whole period and also the monthly rainfall. The height of the plants at the beginning of each month (measurements were made about the fifth in each case) is illustrated on the curves together with the rainfall to the date of measurement from the commencement of the year:—

TABLE SHOWING THE

Species.	Month										
	1921.			1922.							
	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.
Shorea robusta...	+·3	...	...	+·1	..	...	+3	+·8	+3·8	+2·3	+1·1
Terminalia tomentosa.	+·6	+·1	—·1	+·2	.	—·2	+·1	+·[illegible]	+7·9	+14·1	+11·6
Dalbergia Sissoo	...	...	—·1	...	+·2	+3·1	+2·2	+1·0	+8·5	+2·5	+12·9
Acacia Catechu...	—·2	+·1	..	+·1	+·1	—·1	—·4	+·3	+18·2	+17·6	+11·1
Bombax malabaricum	+·2	...	...	...	...	—·1	+·3	+·7	+1·1	+4·4	+1·4
Rainfall inches ..	2·62	...	1·11	3·6[illegible]	·20	..	...	...	5·37	25·99	29·22

HEIGHT OF THE PLANTS.

AND YEAR.

				1923								
September.	October	November.	December.	January.	February.	March	April.	May	June.	July.	August.	September
+1·2	+·3	−·1	+·1	...	+·1	+2·5	+2·0	+6·6	+8·3	+·5	+2·2	+·7
+3·1	−·3	+·2	...	−·1	+·1	...	...	..	+8·8	+10·5	+7·8	+·9
+2·9	−·2	−·1	−·3	+·2	+·2	+4·4	+4·2	+2·0	+8·3	+1·8	+5·5	+1·1
+2·2	−·2	...	...	+·3	+·5	−·2	..	+·1	+17·2	+12·3	+8·3	...
+·1	..	...	.	+·1	+·1	−·1	+·5	+·4	+1·3	+3·8	+1·4	+·2
20·6	..	...	2·0	2·7	5·4	·1	...	·8	·5	19·2	22·3	10·8

It will be seen that the behaviour of the five species is not quite consistent. *Acacia Catechu* and *Terminalia tomentosa* simply follow the rain. They are quiescent or practically so till early June. They then grow upwards vigorously during June, July and August, little or no growth in September and then are quiescent till the following June. *Bombax* is a little different. It stirs to life in April and grows a little during April and May rather more in June, more still in July, tails off in August, again in September and then ceases till the following April. It certainly dislikes the dry hot weather here. Probably under other conditions its growth would be more vigorous during these early months and even here it may show a great difference next year. It is obvious on the ground that none of these *Bombax* have yet begun their period of really rapid growth.

Dalbergia Sisoo starts off in March and grows quite steadily through till the end of June, tails off in July, increases in August, then tailing off in September and ceasing in October till the following March with possibly a slight decrease from frost and drought in December and January or it may start in March and make a greatly increased spurt in June, a half in July and another increase in August.

The *sal* started the second growing season in April, grew more in May and continued steadily till the end of September with a maximum in June. The third season they commenced in March and grew well in March and April and very rapidly indeed in May and June. In July they did little b ut started again in August and grew a lot in September. Other *sal* measured tended to show this same phenomenon, namely, a partial cessation of growth in the rains and an increase again towards the end but these latter measurements were not reliable.

Summary.

It is not possible to make any general conclusions from so few species. Still certain points seem indicated. There is, as would be expected, a close relation between temperature, rainfall and growth.

With all species tested there is a cessation of growth during the months of October to March that is when rainfall is least and temperature is lowest.

During March, however, certain species commence their height growth though the rains have not commenced. Presumably they are stimulated by the rising temperature though doubtless the rain in January and February is an advantage to them. Such species are *Dalbergia Sissoo* and *Shorea robusta. Bombax malabaricum* is probably another but the growth it makes is liable to be counteracted by the tips dying of drought or the whole plant may die down.

Other species commence height growth in June normally when the rain falls but where the rain does not really fall till July (see 1923) these species still commence in June. Such species are *Terminalia tomentosa* and *Acacia Catechu.*

All species whether they commence in March or June grow vigorously during June. *Sal* may grow more slowly in August but seems to commence growing in September. *Sissoo* seems to rest in July but it and the rest grow on vigorously during August and rather less in September. All seem to come to a complete stop in October.

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NOTE ON THE MISCELLANEOUS FORESTS OF THE GONDA DIVISION, U.P.

The revision of the working plan for the Tulsipur forests of Gonda, the preparation of a preliminary working plan report, and the detailed inspection of the forest in the actual preparation of the revised working plan, have combined to give an opportunity to study interesting and unusual types of forests of miscellaneous species, and several interesting silvicultural points are to be noted in the factors which influence their distribution, reproduction and relationship to each other and to the dominant U. P. species, *sal*, which are of sufficient interest and importance to be recorded in a permanent form.

Situation, area, and climate.—The Tulsipur forests occupy the northern portion of the Gonda district. They are bounded on the north by the Nepal frontier, a line running along the foot of a low range of hills (up to about 2,500′), of Siwalik sandstone formation. almost entirely barren and annually burnt, and subject to considerable intensive erosion and landslips. On the south they are bounded by cultivation and village lands, the cultivation frequently running up to the forest boundary, and the population are dependant as much on cattle breeding as on agricultural crops, and keep enormous herds of terribly debased breed of cattle. Between the barren hills on the north, and a seething population of cattle on the south, lie the strip of forests, running 35 to 40 miles in length, and averaging 3 to 4 miles in breadth. The total area is 140 sq. miles, divided roughly as follows :—

(1) *Sal*, 25 sq miles.

(2) Miscellaneous forests of *Terminalia tomentosa (asna)*, *Anogeissus latifolia (bakli)*, *Adina cordifolia (haldu)*, *Holoptelea integrifolia (dhamna)*, totalling 100 sq. miles.

(3) Blanks, river beds, and new riverain forests of *Dalbergia Sissoo (sissu)*, *Acacia Catechu (khair)*, 15 sq. miles.

Climate.—The climate is typical of the submontane belt of the United Provinces, with a hot dry summer, a total rainfall about 50″, and a cold dry winter. Frost, however, is negligible and no sign of frost damage is to be found.

Configuration of the ground, rock and soil.—The essential points to be noted are as follows :—

(1) The soil consists chiefly of a dry loam overlying large sandstone boulders and gravels near the Nepal hills, and overlying a deep loamy sand nearer the southern boundaries. Clay patches and reefs of lime concretion of *kankar* are not infrequent.

(2) The whole strip of forest is intersected by countless ravines and streams, which come raging down in the rains from the bare denuded Nepal hills, and are dry for the rest of the year. They have cut down

their beds with considerable rapidity, which are usually bordered by sheer drops of 15′ to 40′ high.

(3) These main ravines are fed by numerous lateral branch ravines, which are continually eating back into the forests and flat lands and ridges in between This erosive action is materially checked where there is a cover of grass and shrubs on the ground, and where it is not trampled hard, and materially aggravated where the ground is hard and bare.

(4) Between these watercourses, along the greater part of the southern boundary, level or gently undulating stretches of well-grained land are found generally free from denudation, and hence of a character more or less favourable to a good growth of forest. Here and there these fertile tracts are found extending as far as the foot of the hills, but, as a rule, the ground to the north is higher, very much broken and intersected by innumerable dry torrent beds. The high ground in some places is level, but is always dry, unfertile and sparsely covered with stunted trees of no commercial value. Such ground in places, extends southwards beyond the limits of the forests. Springs and perennial watercourses are extremely few in the whole 30 mile stretch of country except at the eastern end, where the bulk of the 25 sq. miles of *sal* forest occur.

Past History.—Previous to 1866, there was no sort of protection of these forests, and they must have been very nearly brought to irretrievable ruin. In 1866 certain trees were declared protected, and firing forbidden, and in 1879 the forests were declared "reserved" under the Forest Act. From 1880 to the present day, the fellings have been extremely light, in the early years there would in fact have been little to fell of any value except *khair* (*Acacia Catechu*), which was practically exterminated between 1880 and 1895 in the manufacture of *kath*.

Grazing.—Previous to 1880, there were no restrictions on grazing, and the intensity of past erosion (evidences of which abound

in these forests), must have been tremendous. Some time before 1890, 60 sq. miles were closed, and 80 sq. miles left open to grazing. In 1895 a further 10 sq. miles were closed, and again in 1913 a further 10 sq. miles of areas allotted to grazing were closed, and fellings and plantings carried out with the object of improving the grazing. The so-called "plantation" areas have given some interesting results which will be noted on below.

These essential points in the description of the tract have been briefly given as they are necessary to a clear understanding of the discussion which follows on the silviculture of these forests.

Description of the forest types.—We can divide the forests into three very clearly marked edaphic formations: (*a*) the dry type, (*b*) the moister type and (*c*) the new riverain type. The dry type clothes all the broken ground, higher plateaux and small ridges, especially where *kankar* reefs outcrop. Where erosive action has been most intense, especially where heavy grazing has operated, we find the ultimate limit of vegetation and shrub growth, consisting of a sprinkling of stunted and gnarled *khair bel (Ægle Marmelos)* and occasional *bakli (Anogeissus latifolia)*, with a few thorns, and xerophytic shrubs, but much of the ground completely bare and surviving trees characteristically perched high on mounds 2′ to 4′ high, which their roots have saved from all pervading erosion around. The worst of these denuded ridges are as bad as anything in the deserts of the Chambal and Jumna ravines, and the total area of this bad type of crop and locality is very extensive. For timber production they are already absolutely useless, and for grass and grazing they very soon will be. In the areas which were closed to grazing over 20 years ago, however the erosion has been to a great extent checked by the soil covering of grass and herbs, while the tree growth, although unfit for timber purposes, is distinctly better and denser. In these slowly improving areas, reproduction of *bakli* (or *dhau* as it is called locally, *Anogeissus latifolia*) is abundant in the bushy stage so characteristic of this species on dry soils, coming up amidst the tufts of *baib* and spear grass *(Andropogon)*, with occasional groups of saplings that have at last commenced to shoot up. Reproduction of *khair*, *Diospyros tomentosa*, and even *sal* when a seed-

bearer of the stunted xerophytic type is in the vicinity, is to be found in fair abundance. Wherever reproduction of *bakli* is comparatively abundant the tree growth is extremely open, and the overhead canopy affords only the lightest of shade and protection. Evidently *bakli* seedlings are intensely light demanding and drought resisting. As we get away from these driest and worst zones, the slopes and undulations disappear and the ground becomes flatter, the evidences of rapid erosion are less conspicuous, the soil becomes moister and conditions of growth improve.

In parts of the tract we find an intermediate zone where there is a young crop of *sain, bakli,* occasional *haldu*, and even *sal* in patches with an undergrowth of coarse grasses, in which the reproduction of all species is still continuing; the soil appears still somewhat dry and evergreen undergrowth is absent. But elsewhere there is a somewhat abrupt change from the very dry type of forest to a distinctly moist type. In this moister type of forest, the principal tree species which monopolise the ground are in order of common occurrence—

Anogeissus latifolia,
Terminalia tomentosa,
Holoptelea integrifolia,
Adina cordifolia,

and on the best soil conditions we often find well grown *sal* gradually ousting other species and monopolising the ground.

These areas give an extremely interesting medley; sometimes each species occurs pure over stretches of 50 or 100 acres or more, sometimes two or three of them are mixed together by single trees or small groups. This peculiar distribution is almost certainly not edaphic, and there are no apparent variations in soil to explain why a species growing gregariously should abruptly give way to another species also growing gregariously or to a mixed forest of several species. *Bakli* and *sain* have hitherto been regarded as at opposite extremes, the first decidedly xerophytic, occurring on loose sandy soils, the second dominating stiff moist clay loams, but one of the commonest mixtures in these forests is an intimate growth of these two species, both obviously thoroughly happy and growing tall straight boles and

healthy crowns. They are also at present occupying soil which by every indication should be growing *sal, i.e.*, a moist fresh and fertile loam of good depth overlying sandy loam or river gravels Whatever be the cause of this peculiar distribution of species in these miscellaneous forests, species varying from an intense light demander like *bakli* to an extreme shade demander like *Holoptelea*, it is perfectly certain that such a mixture must be unstable and with the gradually altering condition of shade and soil (as a result of protection), one or other of the species must in time become dominant and gregarious, and exclude the others. As explained below, this is exactly what is happening.

Œcologically, the study of the undergrowth is important, in the dry xerophytic zone, *baib* grass (*Ischæmum angustifolium)* and spear grass (*Andropogon sp.*) are prevalent and characteristic, with a sprinkling of xerophytic shrubs, such as *Nyctanthes Arbortristis, Carissa spp.* In this zone the shrubs and grasses are useful in preventing erosion, but œcologically comparatively unimportant.

In the moister types of forest, the undergrowth varies markedly with the intensity of grazing. In open areas adjoining villages, and the outer boundary, the ground under the large trees is often completely bare or with a dense undergrowth of thorny and inedible shrubs. In closed areas, the undergrowth is very variable. The commonest species are

on the best soil—*Clerodendron infortunatum, Indigofera pulchella, Mallotus philippinensis, Glycosmis, pentaphylla, Flemingia sp., Croton oblongifolius.*

on worse soil—*Zizyphus spp, Carissa sp. Ægle Marmelos Pogostemon, plectranthoides etc.*

The thatching grass, *Imperata arundinacea,* is common where the canopy is sufficiently open.

The Natural Reproduction.

In the silvicultural study of these mixed forests, a careful study of the state of the existing reproduction is vital, and illuminating. The observed facts are as follows :—

(1) *Adina cordifolia* (*haldu*).—No young regeneration exists After many days of careful search, the site of an old charcoal

kiln was noted with a dozen or so *haldu* seedlings, and one or two young saplings on broken ravine ground were found, but elsewhere, *both in the grazed and ungrazed forest,* no regeneration was to be seen. Considering that this species is at present gregarious over numerous patches, and everywhere abundant as trees about 50 years old, and that every large tree produces millions of seeds every year it is obvious that the œcological conditions for its successful regeneration have completely altered in the past 50 years and now favourable conditions do not exist.*

(2) *Anogeissus latifolia* (*bakli*).—Where this species is growing as a miserable stunted tree under extreme xerophytic conditions, its regeneration is abundant. Where it is growing under ideal conditions for development, forming clean tall boles and fine crowns and a complete canopy (*i.e.* in the moist type), for all practical purposes its regeneration is almost entirely absent *both in grazed and ungrazed areas.* At first sight, this is a singular inversion of what one would except. In certain ungrazed areas however where the canopy is open, and undergrowth light, a few established plants and saplings were noted, also in the moister type of forest, a carpet of *bakli* seedlings was noticed on some firelines.*

(3) *Terminalia tomentosa* (*sain*).—To a limited extent reproduction is abundant, and seedlings and young saplings are found in grassy blanks, on some patches of fresh fertile alluvium in small gaps in the forest not already monopolised by hygrophilous shrubs. But wherever the canopy is fairly complete, and especially where there are dense thickets of *Croton* and other shrubs, there is no reproduction at all.

(4) *Holoptelea integrifolia.*—A decided shade-demander in early youth. Although the large trees are much fewer than the first three species dealt with, over a considerable proportion of the closed portion of the moister type of forest, especially in the west the reproduction of *Holoptelea* is extraordinarily abundant. Numerous areas were noted with a fairly complete canopy of

* *Bakli* and *haldu* seedlings are very sensitive to competing weed growth as well as light demanding. This factor also prevents their successful regeneration.

bakli or *sain* with a complete understory of vigorous *Holoptelea* saplings 10′ to 20′ high. In the western part of these closed Tulsipur forests, the *Holoptelea* reproduction is so widespread and abundant as to amount to an invasion, and there is clearly a succession of woodland types in progress and the light demanding *haldu*, *bakli*, and *sain*, will in another rotation be largely replaced by *Holoptelea*. In the areas open to grazing, *Holoptelea* reproduction is not nearly so abundant, although this species has the reputation of being inedible to cattle. It is undoubtedly grazed by deer, and under the stress of hunger apparently by cattle also.

(5) *Sal.*—In the closed forests of the moist type, wherever two or three healthy seed-bearers occur, the (shade-bearing) *sal* reproduction is found to be coming up in profusion, and to one accustomed to the sickly appearance of young *sal* seedlings of well stocked *sal* forests, this young *sal* appears remarkably healthy. There are numerous pockets and patches of really good soil and growth conditions, where *sal* the apparent climax vegetation of the submontane tract, is monopolising the ground, and gradually ousting all other species, and it is evident that this second invasion of the light demanding miscellaneous species will still further reduce their distribution in the course of time.

(6) *Other Species.*—Reproduction of other tree species noted in these moister miscellaneous forests may be mentioned. *Cochlospermum Gossypium*, *Dalbergia latifolia*, *Eugenia Jambolana* are fairly common in the young plant stage, and are found under fairly complete canopy. There are also moderate to strong shade-bearers. Although light demanding species such as *Odina Wodier*, *Dalbergia Sissoo*, *Hymenodictyon excelsum*, *Albizzia procera*, etc., are scattered about fairly abundantly in these forests, their regeneration is practically negligible, and it is evident that the favourable œcological conditions for their early development have passed.

Grazing.—Before dealing with the problem in forest management which these forests give, a word must be said about the difficult question of grazing. Before 1879, there was no limitation

of grazing, but even in that year complaints were made that the grazing had degenerated owing to fire protection. At the present time, grazing is limited to 19,000 head over 38,000 acres. Areas which have been continuously open for grazing for years have so degenerated that there is practically nothing to graze. They are characterised by completely bare ground or a mass of thorns and shrubs under a canopy of large trees. In 1911-12 an experiment was commenced over 6,000 acres to try and improve the grazing by (1) closure to grazing for 10 years, (2) heavy felling of the canopy, (3) planting of *sissu* cuttings and bamboos. The results of 10 years protection have been as follows :—

(1) On the dry type, a check of erosion, improvement in grass growth, natural reproduction of *khair*, and to a less extent of *bakli* and in slightly moister parts of *Holoptelea* and failure of *sissu* cuttings.

(2) On the moist type, a dense impenetrable growth of *Croton* and shrubs, with occasional very successful patches of *sissu* and bamboos, but generally speaking no natural reproduction of *sain*, *bakli*, *haldu*, and no material improvement in grazing.

These results are suggestive with regard to future treatment.

The new riverain areas.—In abandoned islands and along the banks of the numerous streams, the usual riverain thickets of *sissu* and *khair* are found, the old *sissu* seed-bearers frequently show splendid development and reach very large dimensions. A most instructive example of this type of forest is to be seen near Bankatwa bungalow in the Balrampur Estate lands. About 30 years ago, this bungalow was in danger of being washed away by a wide and torrential stream, and the Balrampur Rajah took the drastic course of beheading it, and with unlimited labour a dam was thrown across its upper reaches, and a broad outlet dug, which effectively diverted its waters into another stream half a mile to the east. In the old bed *sissu* was partly sown and partly came up naturally, and now affords one of the first plantations of pure even-aged fully stocked *sissu* in the province. The trees are 90′ high, with tall straight boles, and the mean crop diameter is about 15″ to 16″, the largest trees running up to 19″ diameter,

The soil is a light sandy loam, and, as may be expected under such conditions, there is over much of the area an almost complete undercrop of *Holoptelea* from seedlings to 20′ high. With a heavy thinning now, a final felling of the mature *sissu* in 15 or 20 years time should produce an enormous revenue, and leave a complete new crop of *Holoptelea* to take its place. There is of course no possibility of reproducing *sissu* crop, and the area is a perfect example of the best method of treatment of *sissu*, *i.e.*, a progressive succession.

The problem of future treatment.—Let us first summarise the established facts. We find:—

An overwood of *sain*, *bakli*, *haldu* with occasional *Holoptelea* and *sal* and other miscellaneous species. The overwood of light demanders is absolutely failing to regenerate itself naturally, but is being subjected to a more or less rapid invasion of *sal*, *Holoptelea*, *jaman* (*Eugenia Jambolana*), and shade-bearing shrubs. The progressive succession is due to protection, which has completely altered the œcological conditions since the present light demanding crop started. So much for facts. Now for possible theory to explain the facts. To a large extent the present crop must have started very soon after protection started (*i.e.*, 1866—79), some cases of the established seedlings were very possibly already on the ground in a burnt and damaged condition, awaiting an opportunity to come up, and from what we know of the œcology of *haldu* and *bakli*, it is clear that the soil must have been largely bare and unstable, with a scattered crop of seed-bearers. An interesting observation supports this conclusion. An old and hollow *sal* stump was observed which had still the clear indications of having been blazed and hammer marked before felling, thus fixing the date of felling as after 1866 (when hammer marks were first introduced). Sometime after felling a *haldu* seed floated into the hollow stump, found favourable conditions for growth, and has developed into a fine tree (growing inside the hollow *sal* stump) of 19″ diameter (= 5′ 1″ girth), tall and brandy, and very typical of a large proportion of the present *haldu* crop. In the areas already invaded by shade-bearers (and this applies to a large proportion of the moister and flatter forests), it has been clearly proved that a heavy felling and

continued protection results in impenetrable thickets of coppice in which no regeneration can be hoped for. It is equally evident that if the canopy is only lightly opened up, the reproduction of these light demanders is equally impossible.

It is an extremely interesting silvicultural problem what system of management to apply to a forest varying from extreme xerophytic to decidedly hygrophilous conditions, and where a progression of crop is obviously taking place. The old "Selection with Improvement" method which has hitherto been followed is clearly useless, since it does not even attempt to ensure that the correct amount of regeneration is obtained, nor the correct distribution of age classes. A periodic block system is essential, and we are left with the choice between mostly natural regeneration under a shelterwood, and clearfelling with artificial regeneration.

The revised working plan prescriptions will be roughly on the following lines:—

(1) Extreme xerophytic areas are unfit for timber production, and are removed out of regular management.

(2) Areas where natural regeneration of tree species may be expected, to be treated under a shelterwood system with regeneration in periodic blocks. But the aim of management will have to be fundamentally different to what is understood in Europe as shelterwood system, where for example an oak shelterwood is designed to reproduce oak, and not spruce or beech. We can either fight nature and the progressive succession or assist it. If we fight it, and try to reproduce *haldu* or *bakli* under the *haldu* or *bakli* crop, we must again bring back the œcological conditions suitable, that is to say bring these areas back to a semi-ruined state, a proposition which no forester would care to suggest. If we decide to assist nature, we must manage our shelterwood of *bakli*, *haldu*, etc., so as to reproduce *Holoptelea*, *jaman* and *sal*, a proposition which no forester has ever yet suggested. But it is not impossible, and to a quite appreciable extent nature has already done it for us. But the invasions of nature are a slow process, and it is undoubtedly difficult to ensure that a quarter of the area will be successfully regenerated by

Holoptelea and *sal* in a quarter of the rotation, *in definite* localities. Also the great danger is that the perfectly worthless invasion of *Croton*, and similar shrubs will come first. To assist nature broadcast sowing of *sal*, *jaman*, and *Holoptelea* under a shelter-wood of *bakli*, *sain*, *haldu* etc., on a floor cleaned up and fertilised by a light fire, is to be tried experimentally on an adequate scale, wherever there are indications that the invasion of these shade-bearing species has already started or will succeed. But in some parts the invasion of shade-bearing species has not yet started and we still find a clean floor under the light demanding over-wood. Here by making extremely heavy openings, burning the refuse, and loosening the soil, it should be possible to regenerate the light demanders successfully, and this will also be tried.

(3) *Areas where the natural regeneration of tree species cannot be hoped for in a reasonable time.*

These include (*a*) areas already completely invaded by *Croton* and similar useless shrubs, (*b*) areas trampled hard by continuous heavy grazing.

For these, almost clearfelling and artificial regeneration are to be prescribed. Possibly in time *taungya* might be adopted for areas suitable for agriculture. There are as already explained two simultaneous invasions going on in these miscellaneous forests, the one a useful invasion of valuable shade-bearing tree species which we wish to encourage, the other an economically useless invasions of worthless shade-bearing shrub, which is in every way comparable to the invasion of moist evergreen into the valuable *sal* forests of the the Bengal Duars, and which we have to fight, and the best way to fight such an invasion as Bengal have proved, is by *taungya*. With cultivation already rubbing our boundary pillars (except where the cultivators have been routed and fled from the onslaughts of the forests fauna), *taungya* should not prove very difficult to introduce. To start with we might tackle some of the few thousand acres which in our misguided efforts to turn into smiling pastures, we have turned into a howling wilderness of shrubs, and now equally useless for pasture or timber production, a standing and visible monument of our

failure which for the sake of our own credit and good name we must remove as soon as possible.

Summary.—Let us briefly summarise the lessons to be learnt from these extremely interesting moist miscellaneous forests :—

(1) Firing, grazing and uncontrolled felling had reduced these areas 60 years ago to a fit state œcologically for the reception of the present light demanding species.

(2) Subsequent protection has so altered the œcological conditions that practically speaking these species can no longer regenerate successfully.

(3) Instead, over considerable areas, the œcological conditions now render possible an invasion of shade-bearers.

(4) This invasion may be divided economically (there is no silvicultural basis in this division) into

(*a*) an invasion of valuable tree species.

(*b*) an invasion of useless shrubs.

The former we must encourage, the latter we must fight.

(5) To encourage the former wherever condition appear favourable, the forests will be managed on a shelterwood system, *with the object of effecting a succession of crops*, *i. e.* from light-demanders to shade-bearers.

(6) To fight the latter, artificial reproduction with or without *taungya* will be attempted.

(7) In areas of P. B. I. not yet invaded by shade-bearers, efforts will be made to reproduce the conditions œcologically favourable for the natural regeneration of the light demanding species. In conclusion it is perhaps unnecessary to add that the Divisional Forest Officer of this Division will have to be a born silviculturist, and an enthusiast in this branch of his work.

E. A. SMYTHIES, I.F.S.

THE STUDY OF A PRIMITIVE COUNTRY AND ITS PEOPLE.— BEING A SHORT ACCOUNT OF THE PAWRAS AND BHILS OF THE AKRANI PARGANA, WEST KHANDESH DISTRICT, BOMBAY, BY H. W. STARTE, I.F.S.—(CONCLUSION.)

Cultivation.—The soil of only a small proportion of the fields is of good quality; such fields are cultivated annually, but the great majority of fields are of inferior soil and are cultivated for a year or two and then left fallow for 3 to 7 years.

The chief crops are *jawari*, *bajari*, *burti* or *banti*, *mor*, *keli-mor*, *sal*, *tur*, *chavali tili*, gram, wheat and *makai*. *Jawari* and *maka* are sown early in the rains, while *bajari* and the other crops excepting gram and wheat, are sown somewhat later. Gram and wheat are sown early in the cold season. In the villages along the river Narbada, *makai* is also sown in the early cold season after the river has subsided. Wheat and *nagli* (or *nachani*) are grown up on the Toranmal plateau.

Jawari is the principal crop in Akrani and is grown chiefly for home consumption. *Bajari* is next in importance. *Makai* which needs heavily manured soil is grown near to the houses and in small quantities only, and is reaped early. *Sal*, *tur*, *chavl* and gram are grown largely for purposes of trade, such as it is.

The more improvident people sometimes borrow seed-grain on the understanding that they will return $1\frac{1}{2}$ times the quantity from the produce.

Many of the Akrani Bhils are poor (though most of them are not so poor as they look, and certainly not so poor as some of the Bhils of the plains), and these are assisted by *tagai* grants for purchase of seeds and plough cattle.

As a cultivator the Pawra is much better than the Bhil and is also much more thrifty, and hence generally better clothed and housed.

A reference to the fruits of the *papaya* (*Carica papaya*) grown in the mission gardens at Mundalwad cannot be omitted. They can scarcely be equalled anywhere in India. One has heard *papaya* fruits likened to soft soap—and perhaps rightly so in

some cases but on a hot day the lucious Mundalwad *papaya* fruit is a food for the gods.

Trade.—As there is at present no communication by carts with the plains there is but little trade. The Bhil generally cultivates just so much land as is necessary to keep body and soul together and to provide himself with *mhowra* liquor. He works on his land till his crop is reaped and spends all the hot weather roaming about and visiting his friends.

Such trade as there is consists chiefly in selling their excess corn and mangoes (of which there is a very large but inferior crop) to donkey-walas from the plains who bring up coarse sugar, cloth, chillies, spices and glass bangles etc.

Mhowra flowers (*Bassia latifolia*) are collected and sold to the distillery for use in preparing liquor, and *mhowra* fruit (*tolambi*) is collected and brought to Government purchasing depôts for eventual export to Bombay and Europe.

Charoli nuts (*Buchanania latifolia*) are collected and the kernels extracted and exported through the agency of the donkey-walas. They eventually find their way to our tables as dessert or are used in the manufacture of high class Indian sweetmeats.

Lac is exported in small quantities, while the distillation of *rosha* oil of two varieties, *viz. motia* and *sofia*, of which the former is the better, is not unimportant. It is prepared in the crudest of open stills. It is doubtful whether the industry is sufficiently large to warrant the introduction of modern steam distillation plant but Mr. Dunbar-Brander's modified still might be tried with advantage as it is not expensive.

In 2 or 3 villages a few Mahars weave coloured loin cloths and coarse white sheets on hand looms.

Brass anklets for Bhil women are cast and prepared in two villages, while silver ornaments—chiefly for the use of Pawras—are prepared at Dhadgaon.

Bhils cannot count beyond 20, and they have been known to receive payment of rupees in small measures.

History.—But little is known of the history of Akrani. It is said that the northern part was formerly subject to local chiefs while the southern part was included in the Muhammadan kingdom of Khandesh till about 1700 when it was seized by Chavji Rana of Dhushvai beyond the Narbada. During subsequent feuds numerous chiefs laid claim to the possession of Akrani, and during this period two forts were built—one on a hill in the south called Akrani, which gave its name to the *pargana,* and the other at Roshmal adjoining Dhadgaon which has already been mentioned. In 1818 the rightful heir Anandsing regained his possession with the help of some Arab mercenaries, but as he was unable to pay them and was moreover mentally deficient, Capt. Briggs, the British Political Agent in Khandesh, paid them off and occupied the forts. The loan of Rs. 18,000 was never repaid and eventually the management of the estates was permanently assumed by the British Government. An enlightened descendant of the old Ranas of Akrani now lives down in the plains south of Akrani and still enjoys a Government pension and bears the title of Rana.

Administration.—As the greater part of Akrani *pargana* is reserved forest and the revenue portion is a chessboard of cultivated lands and unreserved woodlands the general administration including supervision of the local Excise staff, has been entrusted to the Divisional Forest Officer of North Khandesh division who is *ex-officio* Assistant Collector exercising II Class Magisterial powers. The Range Forest Officer, Akrani, is also *ex-officio* Mahalkari and has comparatively recently been invested with III Class Magisterial powers for Abkari cases only.

The police department officials are not subject to the Assistant Collector or Mahalkari of Akrani, however, but work directly under the orders of the District Superintendent of Police.

The manner in which the revenue administration of Akrani came to be placed under the Forest Department may be briefly summarized as follows. The general revenue survey of villages, including their division into "survey-number", was coming to an end in Khandesh. The work in the plains had been completed, not only in the valuable areas under cotton cultivation, etc., but

also in the jungle tracts. Government then ordered the survey of Akrani on the assumption that it was similar to the jungle tracts in the plains. But judging from Government Resolution No. 295 of 15th January 1900 it was not the immediate intention of Government to give out land on survey tenure and at survey rates, but for the time being at least not to proceed beyond measurement and classification.

The survey proceeded very slowly, and when 65 villages in the central portion of Akrani had been surveyed it was pointed out that the conditions of both the country and people of Akrani were entirely different from those prevailing in the plains, and therefore, on the recommendation of the Director of Land Records and Commissioner, and with the concurrence of the Conservator of Forests, the Bombay Government, under G. R. No. 8435, dated 31st August 1906, ordered that the survey should be brought to a close and the whole of the Akrani pargana, and not merely the unsurveyed villages, should be placed under the management of the Forest Department which was chiefly interested in this jungle tract. It was felt that the demarcation of survey numbers would cost much more than it would yield in revenue and moreover that the country would not be ripe for the introduction of a land revenue settlement for many years. Accordingly the revenue administration of Akrani was taken over by the Forest Department; and owing to the law abiding nature of the people, this unity of control admitted of an immediate reduction of establishment. The revenue *talathies* were withdrawn and the supervision of the village *patils*, who collected the land revenue, was entrusted to the Foresters, of whom there were four; and, as the forests were not and cannot yet be exploited, the beat guards were reduced from about 30 to 7, and the village *patils* were made responsible for the protection of the forests near their villages.

The reduction in the number of petty officials has given the people rest from many abuses for which they are truly thankful, and the policy adopted has proved so successful that the local Excise administration has recently been placed under the Forest Department, and now the Range Forest Officer is res-

ponsible for practically all Government administration in Akrani. For this added responsibility he rightly gets a special allowance.

The Divisional Forest Officer makes an annual tour through Akrani, generally taking some 3 or 6 weeks over the trips. During this tour he lives in temporary freshly prepared roomy grass huts, as large tents cannot be carried. His kit is moved by headloads weighing up to 40 lbs. each and in these days he restricts his private and office kit to about 50 headloads. Before the administration was put entirely in charge of the Forest Department the Divisional Forest Officer had great difficulty in securing coolies for shifting camp. This was no doubt partly, due to the lordly way in which things were done in those days for according to an old diary the Divisional Forest Officer engaged 200 coolies, but owing to the impossibility of watching them all as they marched through the jungle in single file many of the men, who thoroughly detested the work, threw down their loads and bolted. So the Divisional Forest Officer's kit was strewn along the track for 20 miles, and it took him several days to recover it.

Civil litigation is practically unknown in Akrani, all quarrels relating to land, produce, and even affairs of love and marriage, being settled by the *panch*. When the *panch* cannot agree the case is referred to the Mahalkari, who is always moving about his charge, and has a very strong influence. In comparatively rare cases are matters referred to the Assistant Collector when he makes his annual tour through the Mahal.

Land tenure and right to fruit trees.—The Reserved Forest boundaries of Akrani are surveyed and properly demarcated, but the revenue lands are mostly unsurveyed. There are 148 occupied villages (besides 8 in forest settlements) in the pargana and, as already explained, an attempt was made to survey them, but when "Survey Numbers" had been demarcated for about 67 villages, the project was given up. Moreover, even as regards the 67 surveyed villages the Land Revenue Code could not be brought into force owing to the habits of the people. They will quit their fields on the slightest pretext, assigning any misfortune

such as a death in the family or illness or loss of cattle, etc., to an evil spirit from whose presence they must flee. This does not, however, deter others in need of land from taking possession of the deserted fields provided they are moderately fertile. Apart from the occupier's readiness to quit, most of the fields (except near Dhadgaon) are so poor in quality that after being cultivated for 1 or 2 years they must be left fallow for 2 or 3 years. Consequently the area cultivated (both as regards position and quantity) is continually changing, and the levy of fixed assessment by survey numbers is somewhat difficult. In olden days the land tax was collected at so much per plough or per axe (in the case of Kumri cultivation; but in 1869-70 this was replaced by the *nazar-andaz* system. Under this system of land revenue collection the Mahalkari and his assistants annually make occular estimates (known as *nazar-andaz*) of the area cultivated, and then assessment is collected on this area at the rate of annas 4 per acre (except on the Toranmal plateau where it is only annas 2 per acre so as to encourage immigrants to settle) irrespective of the quality of the soil. This is really unfair, and some of the better fields around Dhadgaon could easily bear a much higher assessment.

It is understood that there is now a proposal to double these rates immediately, and that in some quarters it is advocated that as the *nazar-andaz* system is so inaccurate a reversion should be made to the old *out-bandh* system, that is that the land tax should be collected according to the number of ploughs actually required to till an area. Flat lands were originally assessed according to this system, and *jhuming*, or shifting cultivation (which is now forbidden), was fixed on the number of axes required to cut the trees on an area and prepare them for burning.

Most of the cultivable lands, whether actually under cultivation or not, are owned by some member of the village itself or of the adjoining village. The right of ownership is claimed under hereditary usage. The Mahalkari maintains Bombay Revenue Form No. 3 for the assessment of land revenue and in it is shown the local name of the field, the name of the person who cultivated it the previous year, and the name of the current year's

cultivator, the acreage cultivated and the assessment to be collected. It also shows the variation between the current and previous year's assessment. The current year's cultivator is regarded as the owner of the field for the time being and responsible for the payment of assessment, and no enquiry is made nor is any record kept of the customary owner. Consequently, so long as a person pays the assessment for the land actually cultivated by him, government cannot dispossess him even though he be not the customary owner of the field, but the Panchayat can.

If a customary owner on account of poverty or other reasons is unable to cultivate all his land he often temporarily entrusts a portion of it to one of his relations free of charge, or he may rent it to others on condition that he receives a certain proportion of the crop raised by the tenant. Sometimes he leases the land for a term of 4 or 5 years, accepting a sum of Rs. 15 to Rs. 25 according to the size and quality of the field, at the end of the stipulated period the customary owner may cultivate it himself or lease it out again. Land is also mortgaged to raise money.

Formerly fields were never sold outright but there has been a tendency of late years to do so. It is to be discouraged as Government is the real owner of the land, and if improvident customary owners are allowed to sell their land at will astute men from the plains, who come to Dhadgaon for trade or are already settled there, will soon buy up all the more valuable fields. It would seem wise for Government to forbid all sale of land in Akrani, whether a survey settlement be introduced or not, just as is done when land is granted under the "New Tenure" to Bhils in the plains of Taloda taluka.

These transactions of leasing, mortgaging and selling etc., are all carried out without any written documents or records, and in case of dispute the matter is invariably referred to the arbitration of a *panchayat* consisting of elderly and influential members of the community or to the Mahalkari or Assistant Collector whose decision is final.

An argument in favour of introducing some form of land settlement for at least the villages containing good quality soil is

that certain customary owners for various reasons neither fully cultivate their fields themselves nor rent them out to others. Thus Government loses assessment on the uncultivated portion. It has been suggested that pending introduction of a settlement a list be made of these fields and that full assessment be charged on them annually whether cultivated or not, and in default that the customary owner of the land be dispossessed, and the field given out to others who are willing to cultivate it.

Time is a factor in customary ownership. If a man leaves village and ceases to cultivate his fields for say 15 to 20 years he loses all claim to the land and trees thereon, and the *panchayat* will not interfere on his behalf to eject any new occupier.

Right to fruit trees.—Mango (*Mangifera indica*), *mhowra* or *mahua* (*Bassia latifolia*) and *charoli* (*Buchanania latifolia*) are the principal fruit trees in Akrani and they ordinarily belong to the planter, who may plant them in his own fields, in waste lands or along the banks of nullas. The right to the trees and fruit descends in equal shares to the planter's male issue.

Sometimes a customary owner will lease his fields to one man but reserve his right to the fruit trees or sell them permanently to another. Thus occasionally a field may belong to one man while the fruit trees on it belong to another. This often leads to disputes as to ownership and such cases are invariably referred to a *panchayat*, and sometimes finally to the Mahalkari for decision. If right to the usufruct of trees is allowed to lapse for some years a claim will not subsequently be recognised by the *panchayat*.

Education.—The first Government school in Akrani was opened at Dhadgaon in the year 1910-1, and later another school was opened at Kamod, but this has since been closed down. Attendance fluctuates considerably, varying very largely with the influence brought to bear on the people by the Range Forest Officer. For the most part Pawras and Bhils do not take kindly to education.

The most largely attended school in Akrani is the Mission School at Mundalwad, and here an interesting experiment has been

successfully tried. Bhili is an unwritten language and for the purpose of securing the Government grant the teaching in Akrani schools has to be in Marathi. A Roman-Bhili Primer has, however, been introduced at Mundalwad Mission School, and it is found that the pupils can learn the Roman characters very much quicker than the Marathi *balbodh* script.

Health.—Malaria is very prevalent in the cold weather, but until recently there was no resident doctor in Akrani. The only medical aid available was a vaccinator, and occassionally a junior sub-assistant surgeon was sent up to tour the *pargana* with a box containing little but quinine! Government has at last yielded to the continuous pressure of successive Divisional Forest Officers and a permanent resident doctor has been sent to Akrani. At present he officiates in the *dharmsala* at Dhadgaon, but it is hoped that a small hospital will soon be provided. Before the advent of the doctor, people who were seriously ill were either carried down to the plains for treatment or left to die unattended in the hills.

Conclusion.—The writer looks forward to the time when he may perhaps go up by the new road to Akrani and see all the developments which may result from it. It will be a pleasure too to see some of his old Bhil and Pawra friends again. They always seem pleased to welcome an old officer.

H. W. STARTE, I.F.S.

THE FUTURE OF BURMA HARDWOODS.

BY CYRIL HOPWOOD, M.B.O.U., I.F.S.

For many years past there has been a stereotyped reference in Government reports and in the speeches of Viceroys and other high officials to the "vast potential resources" of the Indian forests, and after shedding a tear over the fact that these resources have for so long remained "undeveloped," the writer, or speaker, concludes with a glowing picture of the day when the aforesaid resources will be developed, to the great advantage of the Government revenues and the Indian taxpayer.

It is only natural to enquire why, if there is all this wealth of material waiting to be marketed, so little has hitherto been done to turn it to profitable account? The answer lies in the fact that the energies of the Forest Department have of necessity been devoted in the past to the reservation of the more valuable forest areas, a process which secures these forests to the State

for all time; and to the preparation of working plans for those species, *e.g.*, teak, which already have a high market value, thereby ensuring the State forests against over-exploitation.

With a staff admittedly inadequate properly to carry out even this essential work, but little time could be found for the study and exploitation of the less known species, contemptuously referred to as "jungle woods," and it must further be remembered that the training of a forest officer is scientific rather than commercial; the official designations themselves, Conservator, Deputy and Assistant Conservator, imply that conservation rather than exploitation has been the primary duty of the Department, and speaking of the past, this is as it should be.

But although circumstances, as indicated above have been against the commercial exploitation of the less-known timbers of Burma, the output of teak timber has steadily increased, as is proved by the statistics published annually under the authority of the Local Government, and has now reached a figure of some 500,000 tons per annum from all sources. The bulk of this is from forests leased to the large timber companies, The Bombay Burma Trading Corporation, Steel Bros., MacGregor & Co., Foucar & Co., and T.D. Findlay & Sons, whilst the Government departmental operations account for about 25 per cent. of the total, the balance being made up of short-term leases and licenses to smaller firms and individuals, including native traders.

As is probably known, practically all teak timber, except such as has died from natural causes, is girdled previous to felling, and is allowed to stand for an average period of about two and a half years after girdling before being felled. Although it is extremely unlikely that this system, which has stood the test of time, will ever be changed, it has in the past been subjected to much criticism, it having been argued that girdling affects the quality of the timber, shortens the period of durability after conversion, and tends to make the individual stem brittle and liable to split when being felled. The writer, however ventures to express the opinion that these views, which may be theoretically sound when applied to the girdling of timbers in general, do not apply in the case of teak timber, as there is no evidence

to prove, after many years' experience, that either the quality or durability of the timber is adversely affected by girdling; whilst the splitting which undoubtedly takes place occasionally is more probably due to some defect in the individual trunk, to careless felling, or to the impossibility of throwing the tree in the desired direction owing to the extremely difficult and rugged country in which much of teak is found.

On the other side, girdling presents many and great advantages; it permits in the first place, of the timber seasoning as it stands, and of the removal of bark and sapwood by natural causes before felling. The heartwood of the dead tree is not attacked by insects, and a standing dead tree is infinitely less susceptible to damage by ground fires than is a log lying on the ground. Finally, the commercial success of teak exploitation is largely dependent upon the possibility of floating the timber for long distances at very small cost, and a green teak log will not float. In view of the paucity of land transport routes, and the very rough nature of the country, it is well-nigh impossible to make any comparison between the cost of extraction of floatable and non-floatable timbers, but this is immensely lower in the former case. Girdling, too, has a further advantage from the point of view of Government, as the forest rules prohibit the extraction of green teak except in a few specified cases, and it is thus very much easier for the staff to guard against illicit extraction.

Summing up the arguments pro and con, it may fairly be said that the material gain from girdling far outweighs any theoretical or hypothetical loss which the practice may entail.

A far more acute controversy has, however, recently developed concerning the shipment of teak logs in the round, as opposed to the time honoured practice of local conversion and export of timber in the converted state. The shipment of round teak logs was started experimentally by the Local Government in 1921, and the results have been so satisfactory that it has been decided to continue the practice at all events for the present. At first sight it would certainly appear that the shipment of round logs could not compete successfully with that of converted material, on account of the great waste of space incidental to

the stowage of unconverted timber, and the freight that has to be paid on material that becomes waste after conversion. But, on the other hand, it must be remembered that although a good quantity of converted teak is shipped in the form of planks and flitches, a very large percentage of the best teak is exported in the form of squares. Now every teak tree contains more or less "heart," and this portion of even the best square is useless; whilst the process of converting a round log into a square necessitates the scrapping of several inches of the outside of the log; and this material can at the best only be cut up into small scantlings, railway keys, &c., which are only saleable at a low figure and involve additional expense in resawing. For this waste in the conversion of squares, it may reasonably be assumed that the exporter indemnifies himself by charging the consumer a correspondingly higher price for the squares, and it is here that the round log gets its chance of competing. For, given the round log, the buyer in this country is enabled to the best advantage with the minimum amount of waste, and this is of very great importance in the case of teak timber, which is rarely cylindrical and frequently has a "wandering" heart.

It will thus be apparent that intelligent conversion, by the saving of good material effected, can more than compensate for the extra expense involved in the shipment of round logs, especially when it is borne in mind that the extreme outer portion of the log is sound timber, and that plank can thus be cut to the extreme outside of the log, only the rough edge having to be trimmed off. This obviously permits of sawing on any section required, which is, of course, impossible in the case of squares.

Whether it will be possible to continue the export of round teak logs, further experience alone can decide; but the fact remains that during past two years a very considerable quantity has gone into consumption at prices which, to the best of the writer's knowledge and belief, have given satisfaction to all parties concerned.

Allusion has been made above to the "heart" of a teak log and it may not be generally known that a very large number

of teak trees, which, before felling, appear to be perfect, are found, when felled to have a central hollow. Such logs, obviously, cannot be converted into squares, except where the hollow is of very small dimensions, and they are almost invariably cut up into planks and flitches; the converted material so obtained is in every respect equal in quality to that obtained from logs which have no such hollow; and this fact should be noted by those interested in the purchase of round timber. The hollow centre is the commonest defect in teak timber, and its cause is not at present known with certainty, though, in all probability it is started either by the ground fires which sweep through the teak forests annually, or by the larva of a longicorn beetle, which has been found to attack the soft pith of the sapling in the first few years of the life of the tree; very possibly both agencies are at work and are complementary to one another. Be this, however, as it may, the central hollow is not symptomatic of decay or deterioration in the timber of the tree, and emphasis is laid upon this point from the fact that this commonest of all defects is only apparent to the purchaser of the round log: most, though perhaps not all, of the planks offered for sale in this country have been cut from hollow logs, as, had the logs not been hollow, they would almost certainly have been converted into squares. Exception must, of course, be made in the case perfectly sound logs, which by reason of crookedness or deep fluting are unsuitable for conversion into squares; but, broadly speaking, the bulk of the planks are yielded by logs with bad hearts.

Mention was made above of the fact that the output of teak from Burma had now reached some 500,000 tons per annum. and whilst thereis no reason to suppose that there will be any appreciable diminution in the annual average (the actuals for any given year fluctuate considerably according to whether the floating season is favourable or the reverse), it is probable that high-water mark has been reached. The teak-producing areas of Burma are now all known, many of the most important are under regular work ing plans, and the others have been more or less thoroughly explored and estimates and felling schemes have been prepared

for them, pending the compilation of more elaborate working plans. It follows that the supplies of teak available during the next few decades can thus be estimated with approximate accuracy, as in past years considerable supplies have been obtained from old dead and fallen timber, the accumulations of many years previous to systematic management; and whilst this source of yield could not in the past be gauged with much certainty, most of this naturally dead timber has now been brought to market, thereby rendering the task of estimating for the future a matter of considerably less difficulty.

As the possibilities of the teak trade can thus be forecast with a fair measure of accuracy, it is towards the exploitation of the less-known hardwoods that Burma must look for any appreciable expansion in her forest revenues and export trade; and immediately after the conclusion of the war a move was made to find a wider market for the many valuable timbers which had hitherto only commanded a local sale at prices far below their real value.

It must, however, be admitted at the outset that ideas were very ill defined; few forest officers had any knowledge of the requirements of the trade outside Indian limits, or of the uses to which Burmese timbers could be put; and the sale in England at a very satisfactory price, of a cargo of mixed Indian hardwoods, mostly *gurjun* diverted from Salonica after the Armistice, coupled with the boom period of 1919-20, gave rise in some quarters to the belief that a ready market could be found for any of the better species of hardwoods, provided that the timber shipped was of good quality in itself.

A good deal of this optimism arose from the erroneous belief that Burmese hardwoods would be acceptable in England for what was vaguely described as general constructional work, without any particular attempt being made to define this phrase. The Indian builder is compelled to use hardwoods because the combination of climatic conditions and the ravages of the white ant render the use of softwood timbers impossible; but in England, where different conditions prevail, coniferous timbers

are and always will be, used for certain purposes, and in this direction Burmese hardwoods cannot compete, because they are too expensive and too heavy even if otherwise equally suitable.

Next, it must be remembered that the Indian builder and cabinet-maker is compelled to sacrifice appearance to durability and economy. In India (including, of course, Burma) people do not go in for parquet floors, panelled walls, and Sheraton furniture, for the simple reason that they cannot afford them; consequently, the value of timber in India depends upon its soundness and freedom from the more glaring defects. Its appearance when converted is of very minor importance.

When these facts are borne in mind, it is easy to see how the initial mistaken impression arose that any sound timber, regardless of appearance, was saleable; and at the same time, the way is cleared for a consideration of the class of work for which Burmese hardwoods are best suited, and of the quality of timber required for specific purposes.

The experience of the past few years has indicated that Burmese hardwoods are likely to prove most acceptable for such work as flooring, panelling and interior decoration of houses and offices, for counters of business houses, for the saloons of ships, and the internal fittings of omnibuses, railway carriages and lifts, and for furniture making of all kinds, including such articles as pianoforte cases and billiard tables. In fact it is to the architect, the designer, and the cabinet-maker that the principal appeal is made, and from this it naturally follows that the timber supplied must be of the highest quality, and of particularly pleasing appearance if it is to command a sale and to become universally popular.

For each of the purposes above named, as well as for the innumerable other manufactured articles in which hardwoods are used, some well-known wood is already in use: mahogany, walnut, satinwood, oak, to name but a few, have been in use for many years, have been thoroughly tried, and have not been found wanting. Indian hardwoods cannot be expected to leap into popularity at a bound; they must find their place, in the scheme

of things, in competition with the old and well-tried favourites, and with these they must be able to stand the test of comparison in regard to price, appearance and durability. Can they do so? There can be little doubt that the answer will be in the affirmative, provided that these woods are given a fair chance, and are brought to the notice of the public in an attractive manner.

First, as regards price, the cost of the raw material, delivered in England, is certainly no higher than that of other imported hardwoods, and the price of the manufactured article, therefore, depends chiefly upon the degree of craftsmanship that is required to convert the raw material into the finished article. If it be granted, therefore, that the cost of raw material and of manufacture is no greater in the one case than in the other, the prospective purchaser will probably be influenced mainly by the question of appearance, and in this direction the writer is firmly convinced that the Indian hardwoods can hold their own, and more than hold their own, with any of the woods in general use.

As regards sources of supply, although the valuable hardwoods are distributed more or less throughout the province, and are in the aggregate very plentiful, none of them (with the exception of *eng*) are gregarious, and very few can be extracted by water; and it follows that under present conditions a demand for any particular species has to be met by drawing supplies from a number of different localities where profitable extraction is possible under present conditions. Recently, however, the Government has sanctioned a special cadre of forest engineers, and rapid progress is now being made with forest roads to open up hitherto inaccessible localities, and to link up with the existing railway lines and those under construction. But to give some idea of the forests available for exploitation, the large reserves at the sources of the Tavoy river in South Tenasserim may be cited as an example. The writer has some personal knowledge of these, and they have been examined by several forest officers and also by an American lumbering expert. A rough estimate of these forests shows that there are between 300 and 500 square miles under timber, with a stand running from 20 to 30 tons to

the acre, and an estimated stock of 12,000,000 tons of mature timber, about half of which consists of species of the best kinds; such as *gurjun, thingan, pyinma*, Burma mahogany, Burma yellowheart, various species of cinnamon, and many others. These forests lie within a few miles of the Heinne Bay, which has recently been the subject of a marine survey, the results of which will shortly be published, and is believed to afford a safe deep-water anchorage for large sea-going vessels.

Apart from this rich area, in which exploitation has hitherto, been negligible, it may be worth mentioning that during the war and working under unfavourable conditions with an extemporised staff, the Deputy Controller of Timber Supplies handled some 400,000 tons of mixed hardwoods, in addition to 2,100,000 hardwood sleepers, and at the conclusion of hostilities there was a balance of some 40,000 tons of timber and 200,000 sleepers, all of which was disposed of at a fair price. Truly it can be said that the "potential resources" of the province are immense!

As regards these hardwoods, much has already been written about them and their uses in the *Timber Trades Journal* and the present writer does not propose to repeat what has already been published, beyond drawing attention once more to those such as *padauk, gurjun, koko*, laurel, silver greywood, *pyinma*, Indian cedar, Burma mahogany, and *pyinkado*, of which supplies are available. Those who desire to see the finished article can do so at the offices of the High Commissioner for India, where the floors, panelling and furniture have been constructed from the woods above named, and they have also been used extensively in many important buildings in London and elsewhere, details of the work having appeared from time to time in the *Timber Trades Journal*. Finally, attention may be drawn to the fact that Burma timbers and articles manufactured therefrom will be very much in evidence at the Empire Exhibition of 1924, as the province is making a very special effort to put up a really comprehensive exhibit.

In conclusion, the writer has been asked to express an opinion as to the class of sawing machinery most suitable for the

conversion of Burma hardwoods in this country. His experience, unfortunately, has been confined mainly to the circular rack saw in general use in Burma, but this, coupled with his observations in this country, has been sufficient to convince him that the rack saw is very far from the ideal, mainly because it is extremely wasteful. The log frame saw is better, but ties the operator down to converting the log as it lies, without consideration of the quality and appearance of the timber which may be disclosed, and it appears that the best for all hardwoods, including teak, is the band mill, which is inexpensive to operate, gives good and true cutting, and enables each log to be sawn to the best advantage.

[*The Timber Trades Journal, Vol. XCIV, September 1923.*]

TIMBER.

With " The Times Trade and Engineering Supplement " of 28th July is issued a special Timber Section which contains a good deal of information. Mr. F. H. Brown, C.I.E., writes on the **timber** resources of India and Burma which, combined, are second

only to Canada in the Empire. The Forest Department has in its charge over a quarter of a million square miles of country, or more than double the area of Great Britain and Ireland. In addition there are the forests of the Native States, some 55,000 square miles and those privately owned, about 77,000. Mr. Brown pays a tribute to the skill and thoroughness of the work of the Forest Department, nevertheless the Inchcape Committee formed the opinion that the commercial utilisation of this source of wealth left much to be desired. The last annual review of Indian affairs, compiled by Mr. Rushbrook Williams, said that in 1919-20 (a boom year) the outturn of timber and firewood amounted to nearly 340,000,000 cubic feet. This is a large figure, but it represents only about two cubic feet per acre of the forests, and is therefore capable of development. Moreover, India, growing within her confines almost every type of timber, still imports sleepers of Canadian fir, green-heart piles from Guiana, railway carriages panelled with American oak and maple, mahogany furniture, Japanese tea-boxes, beechwood bobbins, and other manufactured woods.

Burma is *facile princeps* among the provinces for its forest wealth. It has the teak, " the prince of the Indian forest," which provides one of the finest and most durable of timbers. But in the past there has been much waste, and trees provide space for dwellings or cultivation were burnt down without compunction. So much was the teak supply, especially for shipbuilding purposes, jeopardised at one time that Sir Dietrich Brandis was deputed to Pegu to arrange for preserving it. Burma has insufficent railways, roads have always been starved of funds, but her potential wealth in forests should be able to afford the country ample transport facilities. Teak has, of course, been exported for a very long time ; later other timbers from India and Burma came to the western markets, *padauk*, rosewood and satinwood, and now *gurjun*, laurel-wood ,silver grey wood, Burma mahogany, *haldu* and Indian white mahogany have also been commercialised. In the London County Hall, Bush House, Bank of England, the offices of the High Commissioner for India, and many other buildings Indian timbers have been used with excellent results ; and the

British Empire Exhibition of 1924 will give India a further opportunity of advertising her timbers and wood extracts, such as resins, dyes, tannins and oils.

An article on woodworking machinery shows that the progress in the arts of converting timber from the log, and in fashioning prepared and semi-prepared material into commercially saleable goods is continuous and unending. What is new to-day is comparatively old to-morrow, and efforts to reach perfection are ceaseless. The "Ransome" combined tree-filler and log cross-cut saw is a valuable machine, the wide band saws have been vastly improved, and have superseded the fast-feed circular saws for conversion work; and there are many other ingenious general purpose machines. If India exploits her timber industry to the full, she will require much woodworking machinery, and it is believed that the British machines will be found more suitable than those of the United States, Britain's chief competitor in that line of work. In the States speed is a prime consideration, skilled labour is plentiful and very highly paid, and a large proportion of the wood is soft. Outside the States speed is not so important, the wood is comparatively more valuable and waste must be avoided, and in India there is much cheap unskilled labour, while skilled labour is dear and scarce. It is understood that timber machinery makers in England are alive to the possible importance of machines for India, and timber machinery may lead to other demands. Wood is a raw material for other industries which may require their own special plant as, for instance, pulping and paper machinery, chemical plant for wood distillation, and tools for joiners, cabinet-makers and pattern-makers. India is already importing woodworking machinery, and a table in the Supplement shows that in 1920 she headed the list of importing countries with a figure of £84,000. In 1921 this figure rose to £218,000, and it fell to £69,000 in 1922 when Japan was the chief importer.

Mr. M. C. Duchesne calls attention to points of importance to all timber consumers and users. It was estimated recently that if the different species of wood that grew in the British Empire were illustrated at the forthcoming British Empire Exhibition,

there would be over a thousand specimens. But to find a market more is necessary than to exhibit samples. Terminology and, nomenclature call for improvement, there should be simple methods, for identification, and data should be given as to tensile strength, durability, and particularly the suitability of a wood for a special purpose or industry. At the British Empire Timber Exhibition of 1920, we drew attention in the display of Indian exhibits to defects of the kind. Many of the names were apparently coined trade names conveying nothing, there were no botanical, vernacular or other names which might have meant something, and there was no information regarding the localities whence the woods came or the uses for which the timbers were more particularly suited.

Dr. Percy Groom, Professor of Technology of Woods and Fibres, College of Science, South Kensington, has a useful article on Technology of Timber. The scientific testing of timber differs considerably from that of the usual materials the engineer is accustomed to deal with. In investigations into the properties of wood, there have to be corrections for the variable factors, moisture, density, shape, structure, direction of the grain, and a careful adoption of precautions, rate and mode of loading, required in testing, to obtain accurate results. The scientific testing of timbers is not simple even when the properties are already known, and it is more elaborate when it is designed to discover the properties and probable uses of unfamiliar woods. In the latter case the static tests have to be supplemented by those on strength under shear, tension and torsion, on fissibility (aptitude to split), resistence to platepressure, nail-holding quality, warping and twisting, and by impact tests. If Indian timbers hitherto little known or not known at all are to be commercially utilised, technology requires more study with a view to gaining more exact knowledge of the essential properties of each timber, and Mr. Duchesne rightly pointed this out. Professor Groom has gone further, and has given much information regarding the necessary investigations which demand the co-operation of experts with full technological knowledge of the structure, physical and mechanical properties and testing of wood, and occasionally the

help of a chemical expert. The *Supplement* is an interesting and instructive publication, and there is much of special application to India in it.

[*Indian Engineering Vol. LXXIV, No.* 10.]

WHEN THE PATROL FLEET PUTS TO SEA.

The grand fleet of the British Columbia Forest Service may not sail the seven seas but it does sail seven-times-seven lakes, rivers, bays, quiet waters, tempestuous waters, wherever the duty of forest protection summons.

Forty-one patrol boats work along British Columbia's inland waterways and long coast line, each with its " beat," each spotting fires, gathering up men and supplies, carrying on along the water routes a protective service that under British Columbia conditions can be secured in no other way.

The Coast Service which takes up 32 of the patrol fleet is no job for idlers. Docking one day last summer, after a hard run into Vancouver, the ranger thus described his experience :—

" At one moment I could see right over Vancouver Island and the next moment the only thing I could see was sea. "

For rough service in the open waters, the patrol ships have to act as the floating homes of the ranger and supervisors. Five of them are equipped with wireless sending and receiving apparatus which keeps them in steady touch with head-quarters.

The fleet boasts of four main types. The flat bottomed dory with out-board motor, is used in shallow water. The lake boats, powered by a 12-16 h. p. engine, with a speed of ten miles an hour, can carry from ten to twenty men. The standard Assistant Ranger launch, which is a 30 feet long, with a beam of 8 feet, carries an 8 h. p. heavy duty motor and will stand two tons of equipment and six to eight men. These are built with a cabin, and pilot house and are of one-man-control type. Then come the Ranger boats, doing seven to ten knots, 30 to 40 feet in length, carrying an engineer who also acts as cook. They

have a cruising radius of 150—200 miles without refilling the fuel tanks.

The first mentioned class of boat is used by patrolmen in the distant sections of the country where there is little travelling and the only fire risk is that occasioned by lightning, the occasionally careless trapper and nomadic Indians. The second type of boat is used in more thickly populated districts such as, in the Arrow and Kootenay Lakes, Shuswap Lake, Cowichan and Harrison Lakes, and is a speedier type. The third type, the standard coast Assistant Ranger 's boat, is necessarily a sturdier constructed boat made to stand the heavy seas which it meets with when fire season is at its peak. The Ranger boat is the home of the Ranger who carries on his normal function of inspecting timber sales, logging operations, generally making logging inspection reports, noting timber trespasses, forest protection work, fire fighting, transportation of men, equipment and supplies, and generally doing the work which a well trained Forest Ranger should do. In addition to the main fleet is a Headquarters boat which is 60 feet long, has a beam of 15 feet, is capable of sleeping eight people, and has a speed of approximately ten knots. This is used for general supervision work by the District Forester and Headquarters officials.—(*Illustrated Canadian Forestry Magazine April, 1923*).

CORRESPONDENCE.

RED COLOURING OF LEAVES.

SIR,—In the October 1923 issue of the *Indian Forester* Mr. Cariapaindulges into what may be called criticism of that portion of my article on "Oecology of Savannah Plants" which relates to red colouring of leaves. He agrees with (or at least does not dispute) the correctness of conclusion arrived at, *viz.* that red colouring screens a plant from the injurious action of heat rays. He, however, objects to the analogy given and contends that this *desideratum* is achieved not by absorption or passage of certain rays but by reflection.

The point where Mr. Cariapa errs and that seriously is, where he thinks that the action of light on a red glass is essentially similar or identical to that on a red leaf. This is not true because while in the former case, the action is purely physical, in the latter case it is largely physiological. To make it a little clearer, if Mr. Cariapa's argument were accepted, chlorophyll, the green colouring of leaves should reflect all the green rays and absorb others. As a matter of fact, chlorophyll absorb chiefly the red rays, and to a small extent the blue rays, letting others to pass, as is evident from its *absorption* spectrum. A plant leaf is not so opaque as Mr. Cariapa appears to think; even a thin film of metal lets some rays of sun to pass through. It may be some rays are reflected just as they impinge on the surface of a leaf, but certainly others do get in and come out on the other side of the leaf, after undergoing that mysterious process of photo-absorption within the body of a living plant.

SHER SINGH, P.F.S.
Kashmir State.

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THE EVOLUTION OF A *SAL* SEEDLING.

Considerable knowledge has been acquired during the last 10 years regarding the conditions which are most favourable for the production of *sal* regeneration, and information is gradually being obtained on the subsequent development of the seedlings. Mr. Collier*[1] in 1914 summarised and greatly added to our knowledge of the conditions of natural *sal* regeneration. The long series of researches and experiments by Mr. Hole*[2] on the œcology of *sal* seedlings threw a flood of light on their early development. Troup*[3] has made an admirable summary of our knowledge of this difficult subject up to 1919. Forest Ranger Ram Rattan*[4] of Gorakhpur produced very successful and vigorous artificial *sal* plantations and Wood has worked out the successful application to large scale operations, on lines very similar to the application of artificial *sal* regeneration in Bengal. The satisfactory solution of artificial *sal* regeneration throws considerable further light on the problem of natural regeneration, and the following note summarises in the briefest possible way the present state of our knowledge regarding the silviculture of *sal* regeneration, indicating what may be considered as definitely proved, and in what points our knowledge

*1 Collier, Working Plan of 1914 for the Haldwani Division, U. P.

*2 Hole, Indian Forest Records, Vol. V, Pt. IV.

*3 Troup, Silviculture of Indian Trees.

*4 Wood, *Indian Forester*, February 1922.

is still incomplete. It assumes that every student of the subject will have carefully read the literature and authoritative writers mentioned above, whose evidence and arguments will not therefore be repeated.

The evolution of *sal* seedlings may be considered under three sets of conditions :—

(1) Artificial regeneration. This naturally is much the simplest problem, as the *sal* seedlings are given the optimum conditions for growth, and the problem has been completely and satisfactorily solved over a wide set of conditions and by many investigators.

(2) Natural regenerations under favourable conditions of soil, moisture and growth. This is a far more difficult problem than the first, and a great deal still remains to be determined.

(3) Natural regeneration under adverse conditions, *i.e.*, on dry slopes, stiff soils, in poor quality *sal* forests, etc. This problem is entirely unsolved at present, and seems likely to remain unsolved for a long time to come.

Let us consider these three sets of conditions separately.

Artificial regeneration of sal.—This has been successfully accomplished under varying conditions of soil in different areas, notably:—

(*a*) in the *bhabar* gravel soils of Dehra Dun, near the western limit of *sal*, with ever-recurring danger of frost.

(*b*) on dry stiff loamy soil of the *damar* forests of Bahraich (Motipur).

(*c*) on the moister loamy and clay-loam soils of Gorakhpur, in poor quality *sal* forests.

(*d*) on the fertile moist *tarai* soils of the Bengal Duars, in areas of optimum *sal* growth.

In every case it has been found that practically complete success can be *guaranteed*, given complete overhead light, thorough soil working, and freedom from competitive weed growth, and

from injury from animals or frost. An excellent description of the steps to be taken, and the details of resulting development of the seedlings to 8-9 months old has been given by Mr. Howard*[5] and need not be repeated here The whole secret of success lies in this, that by these artificial means the *sal* seedlings are given optimum growth condition, which enable them to develop a splendid taproot (thus ensuring sufficient water-supply) and to store abundant reserves of food in the root stock to ensure continuous growth without the necessity of dying back, or even of delaying their development. Both factors (*i.e.*, water-supply and reserves of food) are of vital importance in the growth of a *sal* seedling, as will be explained subsequently. Where soil working and rains weeding can be done, and there is no danger of frost or serious damage by animals, there is not the least doubt that artificial *sal* regeneration is the safest and quickest method to adopt, and if in addition it is possible to carry it out with *taungya* the cost is reduced to very small proportions. In 1923, for example, Mr. Wood in Gorakhpur succeeded in making 63 miles of lines of very successful *sal* sowings covering over 80 acres), despite a poor *sal* seed year and very late rains, at a total cost of under Rs. 150 by means of *taungya* Unfortunately in the bulk of the U. P. *sal* forests neither *taungya* nor artificial regeneration with rains weeding are feasible propositions, and in many forests, the danger effectively prevents any attempt on a large scale, and so we have to depend principally on natural regeneration for the bulk of our *sal* forests.

Natural regeneration under favourable conditions.—As most of the best of the U. P. *sal* forests are rapidly being brought under some form of periodic block system of (mainly) natural regeneration, and the acid test of such system is that *we* can *guarantee* the successful regeneration of definite areas within a definite time the importance of solving the problem of natural *sal* regeneration is obviously very considerable. It is excusable therefore to deal with the evolution of the *sal* seedling under natural forest conditions at some length.

*[5] Howard, *Indian Forester*, December 1918.

The first essential to the successful start of regeneration is the combination of a big seed year *with timely and adequate rainfall.* Past records and observations suggest that a certain amount of seed forms every 2 or 3 years, and there is usually a big seed year every 5 years, but we cannot safely reckon on the combination of ample seed and timely rain more than once in a decade while such phenomenally universal and successful years as 1913 probably do not occur more than 4 or 5 times in a century. There have been fair or big seed years in 1910, 1913, 1915, 1918, 1920, 1923, but of all these only in 1913 and 1918 and partly in 1920 were there timely rains as well (incidentally 1913 and 1918 were both famine years due to the early cessation of the rains). Thus the importance of utilising as much as possible the welcome years of big seed fall and timely rain needs no emphasising.

The next essential to success is a suitable germinating bed. In a well stocked fire protected *sal* forest, the *sal* seed falls on a mass of leaves, and when rain falls and germination starts, the rootlets of the small seedling winds about in the mat of leaves trying to get down to mineral soil. This makes it very difficult, in fact frequently impossible, for the seedling to develop in a healthy and vigorous manner. From the very start, the development of natural *sal* seedlings consists in a series of rushes, with long pauses for storing up nourishment for the next rush. Thus the nourishment stored *in the seed* enables the young seedling to rush up for 2 or 3 weeks, when further development of the aerial shoot slows down, and the rest of the growing season is largely spent in developing the root, and storing up nourishment in the hypocotyl for the future. If then the seedling has to spend a large portion of its precious and limited growing time with its root wandering about in the mat of leaves, it is practically doomed to subsequent extinction. The obvious practical remedy for this is departmental burning of regeneration areas in April as soon as the leaf fall is nearly completed, which has the additional advantage of materially reducing the dense herbaceous undergrowth found in all good quality fire-protected sal forests. This burning of regeneration

areas is now generally recognised and practised (except in dry *sal* forests) in most of the U. P. *sal* divisions.

With the burning of the leaf litter, our practical assistance to natural regeneration ceases. It is usually impossible to work the soil in April and May over large areas, since in the submontane forests labour has disappeared at that time, and anyway the whole expenditure may be wasted by absence of timely rains. The natural seedling is greatly handicapped compared to his artificial brothers, frost or the danger of invasion of tremendous weeds and grasses necessitate a certain amount of overhead or side shade, and *sal* seedlings always develop best in complete overhead light; the soil is unworked even if the leaf litter is removed, with the break of the rains, the herbaceous undergrowth springs up vigorously and further hampers the development of the *sal* seedling. Thus it is quite exceptional for the natural seedling to develop as the artificial seedling does, and with the advent of the cold weather, the mortality amongst the worst developed seedlings commences, and continues steadily through the succeeding months. With the coming of the hot weather a good proportion of the healthier seedlings which are destined to ultimate survival, die back, and the proportion of natural seedlings which never die back, at all is comparatively small. Under the practical working conditions of the U. P. forests, with the impossibility of extensive soil preparation and rains weeding and the necessity of protection from frost, it is difficult to see how this can be avoided. The suggestions made by Hole for securing natural regeneration (*vide* Troup's Silviculture of Indian Trees, Vol. I, page 96) are in effect practically artificial regeneration, and to a great extent impracticable in U. P. forests. But it has been definitely proved that, given timely rain, the enormous seedling production in a good seed year is sufficient to meet the high mortality that must occur, and still leave ample regeneration to cover the ground sufficiently with the survivors. Despite every drawback to which natural seedlings are subject, this fact is indisputable. We may therefore justifiably conclude that the successful natural regeneration of any good quality *sal* forest can be started possibly in 5 years, but with very fair certainty in 10 years, under practical working conditions.

We now have to consider the most difficult point and crux of the whole problem, how to ensure certain establishment of *sal* seedling regeneration in a reasonable time. The' wonderful seedling regeneration noted by Troup*[6] in February 1914 in Lakhmanmandi block, now after 8 years of successful protection from fire and cattle grazing, and with light or moderate fellings of the overwood, has very largely disappeared, and this is but one instance of many that could be given of the gradual disappearance of most promising *sal* regeneration. Recent practice and Working Plans in Bengal and Gorakhpur show that the problem there has been largely avoided by the introduction of *taungya* and artificial work, and since Hole's proposals for accelerating the establishment period of natural regeneration (as mentioned above) include such operations as soil working, rains weeding, etc., it cannot be said that he has solved the problem of *real* natural regeneration without such adventitious aids.

Recent experiments in the U. P., carried out under practical working conditions, and with the careful exclusion of rains weeding, etc., have carried the problem a stage further. Let us continue the study of the evolution of a *sal* seedling from where we left off, that is with a good crop of 1 year old seedlings obtained by burning the leaf litter before a good seed year and timely rains, in the natural forest with moderate overhead shade and the inevitable weed growth. During April, May and June, the seedlings have used up their accumulated food reserves, those which have not died back in putting out new leaves, and increasing the shoot, and those which have died back in putting out one or more new shoots from the collar. With the advent of the rains, if the area has not been burnt, the carpet of dry *sal* leaves becomes a sodden and poisonous blanket, the evil effects of which Hole has so well explained, and simultaneously the *sal* seedlings are overgrown by the weed growth, so that the rains season, which is utilised by the artificial seedling largely in developing its root system and storing up reserves of food for its next burst, becomes for the natural seedling in the forest a time of struggle for existence, and the seedling is greatly handicapped in its efforts to develop its

*[6] Troup, Silviculture of Indian Trees, Vol. I, page 102.

root system or to store up food reserves. However the extraordinary tenacity for life exhibited by *sal* seedlings enables the seedling crop to carry on for several years under such conditions, and in seven or eight years, perhaps one or two seedlings out of a thousand will have developed to a size of 3′ or so, while perhaps 5 °/ₒ or 10 °/ₒ of the original crop will still be existing as plants 6″ to 2′ high, the remainder will have disappeared for ever. The cause of their disappearance is undoubtedly that the conditions of growth in the rains have at last made it impossible for them to lay up food reserves sufficient for the production of a healthy new aerial shoot when the old one dies back. The last stage of a disappearing *sal* plant is the production of a single small leaf on a minute and flimsy stalk, 2″ or 3″ long, and individual plants 7″ to 8″ high have been observed to dwindle down to this last stage in two rains.

The experiments started in 1920-21 in Lakhmanmandi block were designed to improve the conditions of growth in the rains, and although still incomplete, some interesting results have been obtained.

The seedlings were of the 1913 seed year, and the stage of development reached in 8 years of fire protection in several observation plots was roughly as follows:—

Under 9″ height	= 256	= 58 °/ₒ	Average density = 1 seedling per square foot of ground surface.
9″—18″ ,,	= 108	= 25 °/ₒ	
18″—24″ ,,	= 39	= 9 °/ₒ	
Over 24″ ,,	= 34	= 8 °/ₒ	
	437		

4 plots of 25 acres each were taken.

Plot I.—Sal clearfelled, light shelterwood of miscellaneous species left, conversion heavy, trampling and refuse considerable, fire fierce, not fired again since 1921.

Plot II.—Light shelterwood of *sal* (10—12 trees per acre) left, rest clearfelled. Conversion, refuse, etc., as in Plot I.

Plot III.—Left untouched and fire protected.

Plot IV.—Lightly thinned, complete *sal* canopy left, light ground fire burnt each year.

The results of this varying treatment after 2 years may be briefly summarised :—

(1) In Plots I and II, 50% plants still survive, those that have disappeared being chiefly under 9″ original height, and 25% of survivors show appreciable upward growth of 1′ or more, on the average those showing upward growth being mainly 9″—18″ class. The plants originally over 2′ height have tried hard to shoot up, but have been persistently checked by browsing of wild animals. The survivors generally look very healthy.

(2) In Plot III, 25% now survive, of which less than 8% show any upward growth at all and 75% have entirely disappeared. Most of the survivors look very unhealthy, dying back continues.

(3) Opening of the canopy and subsequent burning in Plots I and II has completely eliminated dying back, and the small plants remain perfectly healthy even under the strong growth of grass and weeds that has resulted from the heavy felling.

(4) On the other hand the upward development of the *sal* plants has been disappointing. The smaller plants are so interfered with by the weed growth in the rains that they cannot store up sufficient food reserves to send up vigorous shoots *yet*, although they are healthy and not dying back, while the larger plants (*i.e.*, 2′ and over) which obtain a fair amount of light, have endeavoured to shoot up vigorously, but their new shoots are persistently browsed by *chital* and *sambhur*. It is believed however that this is only a temporary phase.

(5) In Plot IV, the annual burning and fairly complete over head shade have materially reduced the weed growth, and the *sal* plants have remained much healthier than in Plot III, dying back in the rains being greatly reduced although not altogether eliminated.

The annual burning naturally causes a good deal of dying back in April due to scorching. The amount of natural regeneration

has been augmented by a successful seedfall (combined with timely rain) in 1923. It may here be noted that Collier has recorded abundant and almost universal *sal* regeneration 3′ to 5′ high in the well stocked good quality *sal* forests of Nepal, *which are annually burnt*, and considers that a heavy felling, followed by a few years of successful fire protection, will ensure the complete natural regeneration of these forests.

From these observed facts we may justifiably draw the following conclusions, which summarise the present state of our knowledge regarding natural regeneration in *good quality* moist *sal* forest :—

(*a*) When a good seed year coincides with sufficient well distributed rain at the right time, abundant regeneration will be started, even under a fairly complete canopy, especially by previously burning the leaf litter, and leaving a clean floor.

(*b*) Such regeneration will persist for several years even under fairly heavy shade and weed growth, but its development and healthy existence will be stimulated by judicious early burning (*i.e.*, up to 10th, or 15th April) either annually or at intervals of 2 or 3 years. Late burning (*i.e.*, in May) is absolutely fatal to such seedlings, since they have by then largely used up their food reserves, and can send out either no new shoots at all, or only very miserable ones.

(*c*) Collier's observations in Nepal suggest that annual or periodic burning of comparatively moist and well stocked *sal* forests of good quality will in time give good regeneration before the final fellings begin. How much time is required we do not know, but we believe that judicious burning of properly thinned *sal* crops approaching maturity for some years before final or heavy regeneration fellings commence (*i.e.*, while the areas are still in a P. B. II) will considerably assist us in solving the problem of their regeneration when they are put into P. B. I. This

point is however by no means definitely proved yet.

(*d*) We know that *sal* plants 3′ or more in height will benefit by drastic felling of the overwood, we believe that such plants will in time grow out of reach of browsing by deer, but we do not yet know how long they will take.

(*e*) We know that a heavy felling over quite small plants (*i.e.*, under 2′) greatly improves their healthy appearance, but we are not yet certain whether such little plants will be able to grow up through the competing weed growth, and if they can, how long they will take. In future, however, we hope, by heavy thinnings and judicious burning, to get the regeneration 2′ or more high before heavy regeneration fellings commence.

This briefly summarises the present state of our knowledge of natural *sal* regeneration without the adventitious and frequently impracticable aids suggested by Mr. Hole. There are still many gaps to fill up, but we believe our knowledge has advanced sufficiently to justify the adoption of a Periodic Block or Quartier Bleu system of management *with a long regeneration period* for good quality *sal* forests of the type dealt with above.

5. *Natural regeneration of dry sal forests of poor quality*.—Areas typical of this type of forest are the drier ridges and slopes of Siwalik sandstone of the Western Circle, the dry Jaspur Range forests, the poorer *sal* areas of Tulsipur, etc At present we frankly know nothing of the natural regeneration of such areas and since for many of them the quality of locality, and means of extraction are so poor that expensive artificial regeneration cannot be justified financially, we are not in a position to guarantee the regeneration of definite blocks within a definite time either by natural or artificial means, and hence we cannot manage such forests under any scientific or systematic system of concentrated regeneration. For this reason they are perforce relegated to Selection-cum-Improvement or Simple Improvement fellings until the question of their regeneration can be tackled

6. Thus the detailed study of the evolution of the *sal* seedling which has been carried out during the last 10 years by many forest officers in many places has had an important influence on the systematic management of our *sal* forests. The solution of the problem of artificial regeneration enables us with complete confidence to adopt clear felling, where intensive demand for all forest produce exists and artificial regeneration can be carried out on a large scale in practice. Mr. Hole's illuminating researches on the œcology of the *sal* seedling, and practical application of these researches to forest conditions justifies us in believing that we can guarantee to regenerate definite blocks of *good quality sal* forest in a definite time, mainly by natural means, and this justifies us in bringing such forests under some scientific system of concentrated regeneration by periodic or floating regeneration blocks, with a long regeneration period. If there be any who cavil at this claim, there can at least be no denying that we are much more justified in introducing such systems than Howard and Collier were 8 and 10 years ago (when they commenced the Conversion to Uniform Working Circles for Bhabar forests of Ramnagar and Haldwani Divisions), and our present justification has increased by the amount that our knowledge of the evolution of the *sal* seedling has increased during that interval.

E. A. SMYTHIES, I.F.S.

DOWN IN THE FOREST SOMETHING STIRRED.

It was not even an illicit felling nor indeed was it Von Mantel looking for his mutilated formula—it was a large old *mohwa* being removed at last to the great relief of a patch of teak saplings.

One's first general impression of the forests of the C.P. is that they consist of vast areas of scrub growth whose inability to yield much other than poles and firewood is in some measure compensated by a fortunate if fortuitous tendency to produce lac in certain areas.

These impressions, which have no very definite origin, certainly prove correct for a few areas but on the whole they have created and fostered the entirely false idea that the application of

systems approaching those of European forestry in these provinces is but the mirage-like ideal of a few misguided if well intentioned enthusiasts.

When conservancy was first begun in the C. P. the obvious needs were urgent ones of replacing an almost universal crop of badly grown trees and unsightly pollards by a straight, well grown crop; of restocking denuded or devastated areas; and of encouraging valuable species previously hacked out by the various local opportunists in need of them. Further, areas not so badly treated had to be safeguarded against the possibility of such damage, and the total area was to be protected and improved till forests worthy of more detailed and discriminating management were evolved.

These first admirable and highly logical intentions resulted in the production of working plans—all of monotonous sameness which were excellent at the time and most necessary. They embodied plain rules to be obeyed as first principles of forest policy,—but they were never intended or designed for the rigid and lengthy application which has been their lot.

Many of the old plans have been in use for nearly (and in some cases more than) 30 years—without revision or any radical alterations in their now antiquated provisions. In fact in some cases the present need is to save the crops to which they refer from the effects of the latter because large areas of the forests of the province have undergone fundamental changes in stocking and composition.

It is now being realised that by change of method of exploitation we can expect to produce high forest of good quality—that is good compared with the growth of previous years—of at least teak. Not only must the old plans be rewritten and revised but old ideas of the incapability and impracticability of any but the old and wasteful methods must be radically altered.

Formerly the common practice was to sell coupes (by auction) in which trees to be reserved were marked. The contractor was compensated and encouraged at the expense of the forest in that good young teak, etc, were frequently left unmarked The result was and still is (forests being so constituted that they long bear the marks of their previous handling), that over vast

areas badly shaped old trees, often of inferior species, stand over the new generation of coppice shoots. These should of course have received attention in the Departmental "cutting back operations" following the felling which theoretically remove the bad trees that a gently treated contractor was not accustomed to being made to fell. However the funds and staff available for cutting back operations were hopelessly inadequate and the forest often remained in practically the same condition as that in which the contractor left it. Sufficient money was not forthcoming to leave each coupe in a decent condition just after felling—it is therefore not difficult to understand that any opportunity of revisiting the young crops of coppice shoots forming the forest of the future was absent. The present ideal however is now to mark our coupes with a view to the actual improvement of the forest (the former system theoretically had the same object) by marking bad old trees, young trees to be removed in a thinning operation, the worst of 2 or more coppice shoots, etc., all in one, and to ensure that the marking does not lose its silvicultural validity (by insistence on contractors felling all marked trees in the future). Of cases where contractors have been educated to the complete removal of all trees marked—whether they wish to or not, we have fortunately an outstanding example in Bhandara Division which is in striking contrast to the majority of others. The application of the principles is practicable but depends on the firmness of the D. F. O's. and their putting silviculture which involves larger subsequent and sustained yield—before the production of immediate revenue.

Given the combined silvicultural and cutting back, climber-cutting, and general improvement marking operation referred to above, there remains the need for revisiting our congested pole crop—at a first approximation every 10 years. This is essential and is being urged. The old working plans (which did not provide for a definite thinning scheme) are now to be revised and rewritten and it is the present intention to endeavour to thin our promising young crops even to the abandonment of schemes for working virgin areas under old methods. Stock maps will be a novel feature of the new plans and the education of contractors to

fresh and highly distasteful methods essential to sound working (such as felling by sections, etc.), will result in the more efficient favouring of our many long suffering valuable species.

Rumour has it that once we were known as the bow and arrow province by Dehra Dun where our former research has not always found favour or even been in particularly good odour. It may be that we can do better now that we have borrowed their firearms.

As an earnest of recent recognition of the need for organised research in the province a silviculturist has been appointed. The results of the diverse experimental work carried on for years by D. F. O's. and others are now gathered together and recorded in order. Our sample plots are now made to conform with Dehra Dun methods, and future work will be able to be compared with that on similar lines in other provinces.

Our immediate need is for volume tables of teak and sal at least to enable the sale of coupes to be effected on a less speculative basis.

The average C. P. division is of an area of about 800 square miles—the staff has been inadequate, and the funds granted hitherto for forest work far from proportionate to the steady increase in revenue yielded in recent years. A more favourable era is now commencing (for the C. P. forests); more substantial funds have been granted; cultural operations never before hoped for can now be at least tentatively begun while a reorganisation of the staff is under examination. Our young straight crops of teak and other species already inspire us with visions of something better than the conventional coppice crop of 30 years and we now look forward to the creating of forests in which the half forgotten and long neglected methods of Europe may come into their own.

"Meliorasperamus"—a comfortable remark in spite of being the motto of the I. F. S. has here in the past been taken too literally. Compliance with the spirit of it was perhaps rendered difficult by what amounted to the relegation of the selective improvement operation to the financially biassed whims of the

noble army of contractors or to the vernacular silviculturists who masquerade as forest guards.

It was no doubt hard to hope for better things in the past but the time has now come to assist on a large scale our long suffering and surely recovering forests.

We would in fact announce our intention to do a little forestry at last.

Some there be who write to this magazine about alterations to classic formulæ—others contribute copies of notes taken during practical tours on the Continent—while others again write poems about lonely bison bulls and the like.

That the above will serve a purpose at least as useful is the hope of

V. K. MAITLAND, I.F.S.

SLEEPER TREATMENT IN INDIA.

As long ago as 1909 preliminary experiments were started by the Forest Research Institute at Dehra Dun with the object of determining whether or not the treatment of sleepers by antiseptics was possible on commercial lines in India. Such experiments entail determining whether any given antiseptic is suitable under Indian conditions, and whether species of which sufficient supplies are available at reasonable rates lend themselves to treatment, and finally whether these species when treated are durable under service conditions.

To settle the first point a variety of antiseptics were selected, which naturally grouped themselves into two classes, namely, oil derivatives and salts. Of these the former give far superior results to the latter. The next point was to select species on which to carry out durability tests, and due to financial considerations and to the want of proper apparatus in which to treat the sleepers the number of species had to be restricted to five, namely, two pines and three broad-leaved species. Finally some 7,980 sleepers of these five species were treated, four different methods of treatment being used; the antiseptic being

introduced either in open tanks or by means of a small pressure cylinder. The results of these experiments are given in detail in Indian Forest Records, Vol. VI, Part IV and Vol. IX, Part I.

The durability tests have now been in progress some 11 to 12 years, and in the case of powellised and creosoted sleepers the results of these experiments have been so satisfactory that the railway authorities have now taken pratical steps to show their confidence in treated sleepers by creating a large pressure creosoting plant at Dhilwan on the North-Western Railway. Another pressure creosoting plant has been erected by the Assam Railway Trading Co. in North Assam, where the experiments to treat sleepers under pressure were first carried out by the Forest Research Institute.

The Dhilwan plant consists of one cylinder, 75 ft. long and 7½ ft. diameter, capable of dealing with about 1,200 B. G. coniferous sleepers a day, or approximately 350,000 B. G. sleepers a year. The plant is fitted with two powerful oil pressure pumps, two air pressure and vacuum pumps, a high and low level service tank fitted with heating coils, and a powerful up-to-date adzing and drilling machine, to which are attached end-trimming saws. The accompanying photograph gives an idea of the plant, which is fed by two small engines which haul the loaded trucks into the cylinder for charging purposes. These engines are of the narrow gauge type, while the whole sleeper yard surrounding the plant is served by broad gauge sidings connecting with the main line. The layout is so arranged that the plant can be expanded, and two more treating cylinders could be added, so as to bring its treating capacity up to more than a million B. G. sleepers per annum.

The species of timber being treated at present are "*Chil*" or "*Chir*" Pine (*Pinus longifolia*), Spruce (*Picea Morinda*) and Silver Fir (*Abies Pindrow*), on which strength and antiseptic tests have already been carried out in the laboratories of the Forest Research Institute. The former species especially lends itself to easy treatment, and is an extremely useful sleeper when treated; the two latter are rather more difficult to deal with, as it

North Western Railway, creosoting plant. Dhilwan (Beas).
Sleepers being removed from cylinder on trucks.

is difficult to treat the sides completely, though end penetration is very satisfactory. There is however little doubt that by slightly modifying the present process this difficulty can be overcome.

The question of treating broad-leaved timbers presents even a more attractive proposition than treating coniferous woods. For one thing the conifers in India are confined to the hill forests, and therefore represent only a very small proportion of the total available supply of those timbers which are suitable for treatment. From experiments already carried out in the experimental pressure plant now installed at Dehra Dun it is evident that the *Dipterocarps*, of which large quantities are available in Burma, Assam and the Chittagong Hill Tracts, will treat easily; while the durability tests carried out for over 10 years show that these timbers are very durable after treatment, and have a life in the line of approximately 10 years. Many other Indian species treat well, more especially *sain* or *asna*, known in Burma as *taukkyan*, a very hard wood and eminently suitable for sleeper work. Finally if this question of treating sleepers antiseptically is to be taken up on a large scale it is most essential that suitable centres of collection are chosen where a large number of sleepers can easily be collected, and where treating plant can be erected. If this is done, not only will the question of supplying sufficient sleepers to Indian Railways be largely solved, but it will have the further beneficial effect of stabilising the sleeper market and finding a new use for many of our Indian hardwoods.

R. S. PEARSON, I.F.S.,
Forest Economist.

Abnormal chital head contrasted with a normal head.

AN ABNORMAL CHITAL HEAD.

I send you for publication, a photograph of a freak of nature in the way of a pair of Chital (Spotted Deer) horns.

I first observed the stag carrying these about the end of April 1921 when I was shooting in a little visited shrub jungle in the hope of securing one of the good heads I knew were there.

3

I shot a stag in very open jungle and the report of my rifle put up seven hinds and one stag (this freak). The stag ran to my left and stood on a ridge barely 100 yards away and I could not but immediately notice the extraordinary horns which he carried. He gave me a splendid shot, broadside on, but I missed him and later discovered that the second leaf of the backsight was up. I promptly followed the herd and saw them crossing a piece of open country, making for another patch of jungle and I emptied my magazine at the stag but with no result. I continued following them up and came across the stag who had his horns badly entangled in a big *karonda* bush and making frantic efforts to get loose, but before I could get round for a shot he disentangled himself and disappeared, and though I searched the jungle thoroughly in a scorching sun all day, I never saw him again on this occasion.

On another visit to the same jungle I did not come across this stag but on a third occasion I saw him again and this at the end of the day when I had given up all hopes as I had worked hard in a thorough search of the surrounding jungles.

I was returning to my headquarters through the jungle when I saw a couple of hinds with a good stag looking at me and shot the stag and when they made off, I discovered to my chagrin that the object of my search was in the herd. I took a running snap shot but another Cheetal (female) intercepted and so I again lost the trophy, the possession of which had now become an ambition if not an obsession. Unfortunately, I did not get an opportunity to go out again.

In August I sent my *shikari* out to see if the stag was still there and report on the condition of his horns and he brought in the horns numbered (2) in the photograph, these had been picked up by a grazier, in the vicinity.

From then onwards I had him very closely watched to see if he would grow freak horns again which he did and in April 1922, having been informed that his horns were no longer in velvet, I went out and shot him with the horns, numbered (1) in the photograph.

Quite apart from being an abnormal freak, it clearly establishes that freak horns are permanent and not only confined to one set. I may mention here that besides this freak, the stag had no other visible defect about him which I could detect.

The horns numbered (3) are those of a natural head ($36\frac{3}{4}''$), in order to show the vast contrast.

B. A. PARR,
Inspector of Police,
Central Provinces.

REVIEWS AND EXTRACTS.

FOREST INSECTS OF AUSTRALIA.

BY W. W. FROGGATT, F.L.S.

Forestry Commission, New South Wales, Sydney, 1923; pp. i—viii, 1—171, 2 coloured plates, 44 black-and-white plates, 33 text-figures. Price *7s. 6d.*

Mr. W. W. Froggatt, the veteran government entomologist of New South Wales, has produced a very attractive little volume on the forest insects of Australia, which is illustrated with numerous, exceptionally good line-drawings, photogravures, and two coloured plates.

Forest entomology, *per se*, has received little attention in Australia, and no special research on the biology and control of pests has been done. Nevertheless, the author has collected sufficient information on the life-histories and food-plants to form an interesting account of the general conditions under which insect damage occurs to forest trees. The insects are grouped according to their principal hosts, *e.g.*, Eucalypts (chaps. IV—VI) Sugar gum, *kurrajongs*, Wild pomegranate, Wild lime, wattles (chaps. XI—XIV), red cedar, figs, *Casuarinas*, *Banksias*, pine, cypress and *kauri*. On account of the dominance of the two large groups of eucalypts and acacias, and the absence of oaks, chesnuts, poplars, etc., the author considers that the forest insects of Australia differ from those of other portions of the globe, and "in fact, our native trees are more open to attack, because we have no efficient feathered allies, such as the wood-peckers of Europe and America."

It is evident from a perusal of the book that Australian conditions have much in common with those of British India, particularly in the development of the borers of living trees. The *Cossidae*, *Hepialidae*, *Tortricidae*, *Longicornia* and *Curculionidae* have important representatives, among which the giants *Leto staceyi*, and *Zeuzera macleayi* (with wing expanses of 6 and 10 inches) are worthy of note. The ambrosia beetles or shot-hole

and pin-hole borers (*Platypodidae, Scolytidae*) are however relatively unimportant and only one species, *Platypus omnivorus*, is mentioned. Of the borers of stored or unseasoned timber very little appears to be known, and there is a tendency to confuse the work of *Lyctidae*, *Bostrychidae* and *ambrosia* beetles. This has resulted in considerable anxiety over the possibility of introducing borers in timber imported from the Malay Archipelago and the Pacific, and in packing-cases, or tea-chests from India, Japan, etc., or in wooden ventilators used for rice cargoes from Burma.

The author is not always up-to-date in his information on the progress of entomological work outside New South Wales, particularly with regard to timber insects. The account of *Lyctus brunneus* (which is erroneously placed in the *Cioidae*) makes no reference to the work of Altson, Snyder, Kraus and Hopkins. The account of the methods of dealing with white-ants does not teach us much and has nothing more modern than a note in the *Indian Forester* for 1914. On page 21 the author states:- "During last year a committee appointed by the Indian Railway Board made an exhaustive inspection of Australian sleepers on Indian Railways." As far as the reviewer is aware this committee actually published its report in 1911. In dealing with the genus *Hylesinus*, to which the fig-branch borer is incorrectly referred, the author records 13 species on the authority of Chapuis, 1869, being apparently unaware that some 40 species have been described since. In the case of the shoot borer of *Cedrela australis* (*Hypsipyla robusta*) illustrated under the name of *Epicrocis terebrans* Olift in the plate on p. 136, no reference is made to the life-history studies in *toon* published by the reviewer in 1919, *Indian Forest Record*, VII, vii, or to *Queensland Forestry Bulletin*, No. 3, pt. 1, 1917, or *Australian Forestry Journal*, I, 1918, or Tectona, XV, 1922.

Mr. Froggatt does not appear to be very well acquainted with the names of the pioneers in entomology. Thus the altmeister of forest entomology, Ratzeburg, is termed " Ratzenber " on p. 144; Degeer becomes " Dr. Geer " on p. 30 and in the altme ister Geoffroy is " Geoffery "; Herbst is " Herbest " on p. 28 and 2

lines further on Chapuis is " Chapius " ; Gemminger and Harold become " Deharold " on p. 24 ; Chevrolat on p. 26 is " Cheverolet". There are several errors in the scientific names, *e.g.*, "*Tomicus typographagus*" for *Ips typographus* on p. 144.

When dealing with the scale insects or *Coccidae* and the lerp insects or *Psyllidae* Mr. Froggatt is on more familiar ground and his treatment of these groups is authoritative. It is however unfortunate that it has been necessary to describe several new species in a text-book " of value by those interested in Forestry, Architecture, or industries in which wood as a material is employed."

C. F. C. B.

SOWERS AND REAPERS.

A TALE OF THE FORESTS.

(*I.—The sowers*).—In all Randungar there was festivity—taluka and town alike. Medars and Sonars, Kunbis and Mahars, all had sunk the antipathies of centuries in a great rejoicing. Goats and fowls were sacrificed, houses and temples festooned, every panther-god in every jungle *khind* was flaming scarlet and the *mowhra* spirit flowed strong and rank, the people's own brand, brewed in the silent ravines. For the impossible had come to pass. The forest staff had been removed, the forest restrictions with them, and the forests themselves were restored to the people.

Not without pains had the feat been accomplished. The mass of privileged prejudice had been hard to move. The people it is true had taken little part in the campaign. They had weakly acquiesced in what they had considered their fate. Petitions they had sent in from time to time, on minor grievances. These had sometimes been removed, the requests sometimes granted other times not. But these things hardly touched the root of the matter. The forests were theirs but they owned them not This was true. Because Pesterchand Chatterchand Vakil had told them so. He had been telling them for twenty years. And now he had told the Assembly and the Assembly believed him. For who could resist his presentation of the matter ?

". . . . . . This policy of rapacity is as insidious as it has been continuous. One by one the ancient rights and privileges have been filched from a thrifty and fore-sighted people. whose one fault has been their submissiveness. By slow degrees the absolute rule of a narrow oligarchy has been established, the strangle-knot on the oppressed ryot tightened to its last twist. Where cattle roamed at will is now the obnoxious "closed forest" demarcation and the cattle pounds overflow in every village. No longer may the husbandman build him a roof for his grain shed, still less to shield his family from sun and rain. The revenue and agriculture officers encourage him to double his production of flour, the forest officials deny him the fuel to bake it with. The very fruits of the forest are denied to him. Will he fence his field against wild animals? He must first pay half the value of a possible crop. Will he lop for ash-manure as his fathers did? A thankless task, when wood for the plough and sickle and cart are obtained at the cost of his freedom. The forests have been the ryot's from time immemorial. They are his now but he owns them no longer. For he has been robbed of them by a rapacious department, working for its own glory and profit under the name of forest conservancy. It is for you to restore them now."

Pesterchand has scored and the forests were won back for the people. Hence the festivities in Randungar. To-day his name was on every lip, his praises sung after every leaf-full of *mowhra* spirit. "The forest is ours and now we may live," they shouted.

Only one man was silent and that was Koyaji Bhiku, the Shikari. He had been woodman and cartman, road-maker and fire-tracer in his day, indeed he had followed all the jungle trades and thriven on his wages. But the chase had been his joy and pride and though his step was slow and a bear-clawed shoulder had maimed his upright gait, his eye was clear and his voice steady. He was a great teller of sporting yarns and he would warm to his tale over a bottle of *mowhra* in the weekly market place of the little town. To-day he took no part in the rejoicings. He chewed his tobacco and spoke not. But in so gay a gathering

so crouse a crony was not to be permitted to remain silent and the Kunbis and Mahars rallied him on his glum appearance in the midst of the general gaiety. Then he rolled the leaf in his cheek and spat with zest and they knew he was going to deliver himself and stood round and listened. He did not declaim but he slowly traced the pug of an enormous tiger on the soft dust with his palm and fingers while his furrowed forehead told of the inner searching of his brain and then he quietly spoke :—" I like this not. Good may come but it will not last. I knew a forest saheb long ago. He beat me for lighting the forest on a windy night when I was a *mukadam* of fire-tracers. But when I was mauled by the bear on Jamniabari and lay by for three moons and Jiwanji Makanji sued me for my rent he paid up and I was free to hunt with him again. Many a time we lay among the bracken listening for the sound of the bison crunching the sweet young shoots of the bamboo, and then he would talk. He was none of your baboos and he would take two Brahmin Rangers separately of a morning's outing and walk them till they said the Prant was inspecting the treasury and they must go and show their balances. Well, we would sit and he would tell me things. They were not things of a day or a month or yet of a year, but concerned generations and centuries and aeons. I am old and cannot remember. It will see me out and may be my sons, but the division saheb was wise and he said, 'you cannot eat your nagli cake and have it too.' So go on with your dancing."

A time of unparalleled prosperity and contentment followed the consumption of Pesterchand's political activities. The *ryot* waxed fat. His cattle multiplied for could he not now let them graze at will, without fee and even among the young plantations of *sissoo*, whose tender leaves after the hot-weather showers were green when grass was dry and stale? And why cut the *dhaura* trees flush with the ground when you wanted an axle for a broken-down cart? True, no coppice-shoot would come up to replace the tree when you had hacked it over breast-high but that was the easy way and saved your back and there are thousands of *dhaura* trees in the forest. The same with *dhamni* poles and yokes and *tiwas* for shafts and cart frames. There was a great bother befo.e

about these. Not only had you to get a written permit before you could cut even one, you must trim the stump and use all the wood of one tree before you might have another. What nonsense! As if there were not a lakh of acres of *gairan* in Randungar alone. Then there were the fencing stakes. It is true the Commissioner sahebs over-ruled the jungle sahebs because their pay was bigger and there was always the chance of becoming a Member and wild pigs are a sure draw with committees who come round and get *bhatta* and are called Rao Bahadur, and so you were given even the fencing stakes free. But what restrictions! It was not worth while to have them. You had to send in lists of areas you would fence to the Mamlatdar, and even then you were not allowed to use the stakes for fuel or for *rab* on seed-beds, but were told to make them last two seasons and collect cowdung and dead-wood to burn. And after all you might not have teak and forbidden species because they were wanted for house-building and revenue, as if there were any limit to what the forest will produce! Now you may for fencing cut over the five-year-old teak coppice without let or hindrance, and when that is used up there is always the *ain* and *nana*.

Then there was the lopping of branches for ash-manure called *rab*. Was ever so silly a fuss made over so simple a matter, ever a privilege so ringed with needless restrictions? You might not lop the same trees two years running. You must not lop the top off the tree least it cease growing. Of course, if you got a forest officer on the quiet even he would admit that cutting the top off a tree actually increased the growth of side branches. But catch him admit it on paper. Again cutting *tahal* from young and hopeful saplings was anathema. Did not a certain collector come out and lecture the admiring crowds as follows? "A dog has six pups. They all drink the milk. Therefore no pup grows big. What do you do? You kill five pups. What happens? The remaining pup drinks all the milk. It therefore grows large. So it is with the six coppice shoots from one stump. You may cut five but keep one, it will then grow to a tree." True, as Deoji Kalu pointed out when the collector had gone, you might as well

say, cut off all the hairs on a man's head but one, it will then grow as thick as your leg. But nobody grudged the Collector Saheb his metaphor. After all he must be right for he is paid to do no wrong. What the Sarkar says is true. That was in the old days. Now it has been exposed. You may lop as you like. Spoil the trees for timber? Maybe, but there is plenty at the back of the hill. Then the everlasting bug-bear of fire protection. Refined *zulum*, run riot. In the last century fires were practically unchecked, everything was burnt over every year. Not only did the forest remain but firing benefited the ryot. Each hot weather saw the hills adjoining fields covered with a wood-ash. The rains washed it down and fertilised the fields. Fire-protection stopped these advantages and oppressed the cultivator. But now it was all right. The supply of wood-ash was renewed. New grass would come up early with the first showers and the cattle would flourish. Another scandal had been exposed. Strict conservancy was squeezing the ryot out. The forest encroached more and more on the cultivator and he might not clear it back. Pig and other noxious animals preyed on the crops, tiger and panther on the cattle. The concession of clearing wide strips round cultivation of undergrowth had been useless because timber trees might not be cut too. The forests were the cause of the malaria fiend which stalked unchecked. Pesterchand had changed all this. The villagers could unite to clear all tree growth within a mile of habitation and they eagerly began to do so. The fine teak pole belt round Palaskhond a long narrow strip cultivation containing two huts, was soon cut down and the timber used for grain-stores, look-out machans and cattle-sheds, and new cultivators poured in to take up the long-deserted lands.

And so with the wild fruit trees. Kalu Patil knew all along that if you girdled them with an axe you increased production by a hundred per cent. (for that year). He proceeded to practice, with the co-operation of all, and with the result that a good trade with Randungar town was established and the cash emoluments of the lesser villages went up with little effort on the part of the producers.

A time-honoured practice revived, long fallen into disuse through the obstruction of theorising forest officers. This was the lucrative practice of shifting cultivation in the forests after burning. Why restrict field crops to flat soil which require constant manuring from outside, entailing severe labour for mediocre result? Let nature yield her unstinted abundance. Cut, burn, throw seed in the ashes, sit and smoke and reap a rich harvest. Next year go but a little way further up the slope and do the same. By the time you have got further into the hills than you care to climb you can begin again on the regrowth from the first year's clearance.

And so it went on. Rents were paid with ease. *Sowkars* were even paid off their debts of a former generation, capital and compound interest. Staggered by such unwonted treatment they retired from the scene and left a contented loyal rural population to deal direct with their original landlord, Government. Peace and plenty reigned. Floreat Pesterchand!

But Koyaji Shikari sat and smoked, and was silent. Aged and bent, he no longer took part in the hunting. Shikar was free to all, so why should he trouble? There was no glory left in it, no saheb to lure to tiger, panther, bison, bear. Only now and then he would lift his head as his fat son strolled in from the Randungar market and would murmur "I like it not. The Saheb told me things. They were not of a day or a month or yet of year. Good has come but it will not last." And no one heeded him.—[*Times of India.*]

PYINKADO.

A Supreme Wear-resisting Wood.

The artist or the craftsman who believes in himself must see to it that the material in which he works is the most suitable for his purpose. It may be fitting that American machinery should be made to last but a short time on the grounds that it will be superseded by a better design before its life has ended. It is not so with the artist, like Stradivarius as sketched by George Eliot.

"I say, not God Himself can make man's best
Without best man to help Him. I am one best
Here in Cremona, using sunlight well
To fashion finest maple till it serves
More cunningly than throats for harmony."

We picture

"That plain white-aproned man who stood at work
Patient and accurate till four-score years
And for my fame, when any master holds
'Twixt chin and hand a violin of mine,
He will be glad that Stradivari lived,
Made violins, and made them of the best"

The artist, who is careless of his pigments may in his own life-time see his picture fade. The architect who chooses his stone amiss—or his successor – may find his building crumbling under the influence of a city's smoke. So, unavoidably, and with no reproach of carelessness on the part of the artist, we find at a long last the beautiful timber roof of Westminster Hall attacked by the anobiid beetle (*Xestobium tessallatum*), and now made durable with steel.

It is regrettable perhaps that the great work of the artists of a by-gone age should now be made in some sense a sham. Purporting to be wood, it now largely depends on metal, and is no longer the *bonâ fide* sincerity its creators built They had at their disposal the best of English oak; we can imagine with what care they searched for the best that Nature had produced in these islands.

We may read in the Records of how "John Godeney, Clerk of the Works, is appointed to take by land and set all the King's timber in the wood of Pettlewode in the County of Sussex to the Port of London for the King's works within the Palace of Westminster."

So, too, with the beautiful 16th century roof of the Middle Temple, the Hall of which has been the scene of many historic incidents since Queen Elizabeth was entertained there after the completion of the ten years' labour by which it had been built

Now this same destructive beetle has attacked the oak roof, which will in all probability have the same strengthening of metal to keep it intact.

The artists who created these works considered that in British oak they had the best material possible. They knew nothing in those days of the wonderful products fashioned in Nature's workshop in other lands. To them the forests of India and Burma were unknown. Though philology has proved that the precious cargoes of King Solomon's merchant ships came from the ancient coast of Malabar ; though the brilliant mediæval republic of Italy drew no small share of their wealth from their Indian trade, and though it was the hope of participating in this trade that stipulated Columbus to the discovery of America and Vasco da Gama to the circumnavigation of the Cape of Good Hope, yet the temptations which allured these adventurers from Europe to the East lay rather in the jewels and gold and silver ; in the fabrics of silk and cotton ; and in the spices and drugs, rather than in the valuable timbers which were to be found in the dense virgin forests which clothed the hills and valleys. Not till within the last year or two have these become part of the trade of the East with Europe.

Amongst these timbers is one which in Burma is second only in reputation to teak, and this is the *pyinkado*, or iron-wood, of Burma. It is found throughout the greater part of that province but is probably most abundant as well as most accessible in the forests of the Pegu Yoma, the low range of hills running up the middle of Burma, and forming the water-shed between the Irrawaddy and the Sittang rivers. Here this great tree, with its fragrant flowers, grows to a height of 120 feet with a girth of 12 feet or more. The wood, reddish-brown in colour, is hard, tough, strong and rigid, and of a durability that is possibly unsurpassed by any other timber in the world ; in addition, it is not subject to the attack of the beetle which has destroyed the oak in the Westminster Hall. That a wood should exist which was heavier than water, more indestructible than iron, more durable than teak, would, we may conjecture, have been of the greatest interest to

those who wrought those timbered roofs centuries ago. Less than three hundred years from its erection the roof of Westminster Hall had begun to need repair. How long might it have lasted had *pyinkado* been used, a wood of whose compass we can conceive not in centuries, but almost millenniums ?

This timber is now actually on the market, and almost illimitable supplies are forthcoming from Burma ; they are available in lengths and sizes suitable for every purpose for which the wood can be employed. Three hundred years ago a national product was deemed the most suitable for such work as these roofs; as the nation has expanded, so has its needs, and as the Empire has grown, so also has the store-house of natural wealth, so that if the artist is to choose the best material possible for his work, might he not with as much appropriateness choose *pyinkado* to-day, and thus still give preference to a product of the British Empire.

Another interesting use for which *pyinkado* could supersede oak is for timbers upon which are hung the bells in a belfry. The belfry was originally constructed expressly for the bells, in order to save church towers from injury through the vibration of enormous masses of resonant metal ; the derivation of the word "bergen," to protect, and "frida," safety or peace, shows this plainly. Belfries were once perhaps of more practical use than they are now, for the bells summoned soldiers to arms as well as Christians to church, and sounded the alarm in fire or tumult. They have rung alike over slaughtered and ransomed cities, and far and wide throughout Europe in the hour of victory or irreparable loss. The subject is a fascinating one. The bells themselves are the life of these old church towers, and they are often of great value, richly, decorated and inscribed. Their weight is often considerable ; the great bell at Moscow was said to weigh 198 tons. The largest whole and hung bell in the world is said to be the bell in the Buddhist Pagoda at Mingun in Burma, which was cast by King Bodaw Paya, in the 18th century, it weighs 90 tons It is obvious that the timber upon which the great bells hang must be exceedingly strong and durable. Father Le Comte, a Jesuit missionary, wrote of seven

enormous bells at Pekin which proved too heavy for the Chinese tower, and one day they rang it into ruins. The bells in the Westminster Clock Tower are swung from an iron framework, but these columns and girders lack the particular dignity which belongs to the rafters of the more ancient towers, and timber will probably continue to be used for this purpose. Oak has for centuries been the only wood employed, but the heaviness, the strength and the durability of *pyinkado* may well recommend it for the future.

Indeed, the uses of a timber with the peculiar qualities of *pyinkado* are almost too numerous to catalogue. It can supplement greenheart for piles and dock work, and teak for ship building. It can be used, as the Madras Government use it, for gun-carriages ; it is suitable for railway wagons, for paving blocks and for all kinds of building and constructional work, and it may well be described as the supreme wear-resisting wood.—[*The Timber Trades Journal, Vol. XCIV, No.* 2456.]

GERMANY'S BLACK FORESTS.

Seven hundred years ago the area of Black Forest of Germany formed part of the large estates of one of the Counts of Eberstein, concerning which gentleman nothing more descriptive can be said than that he was a typical and inveterate crusader. Time after time, he rallied his retainers about the ancestral banner to set out for Palestine, and as often returned home with only a ragged remnant of his band.

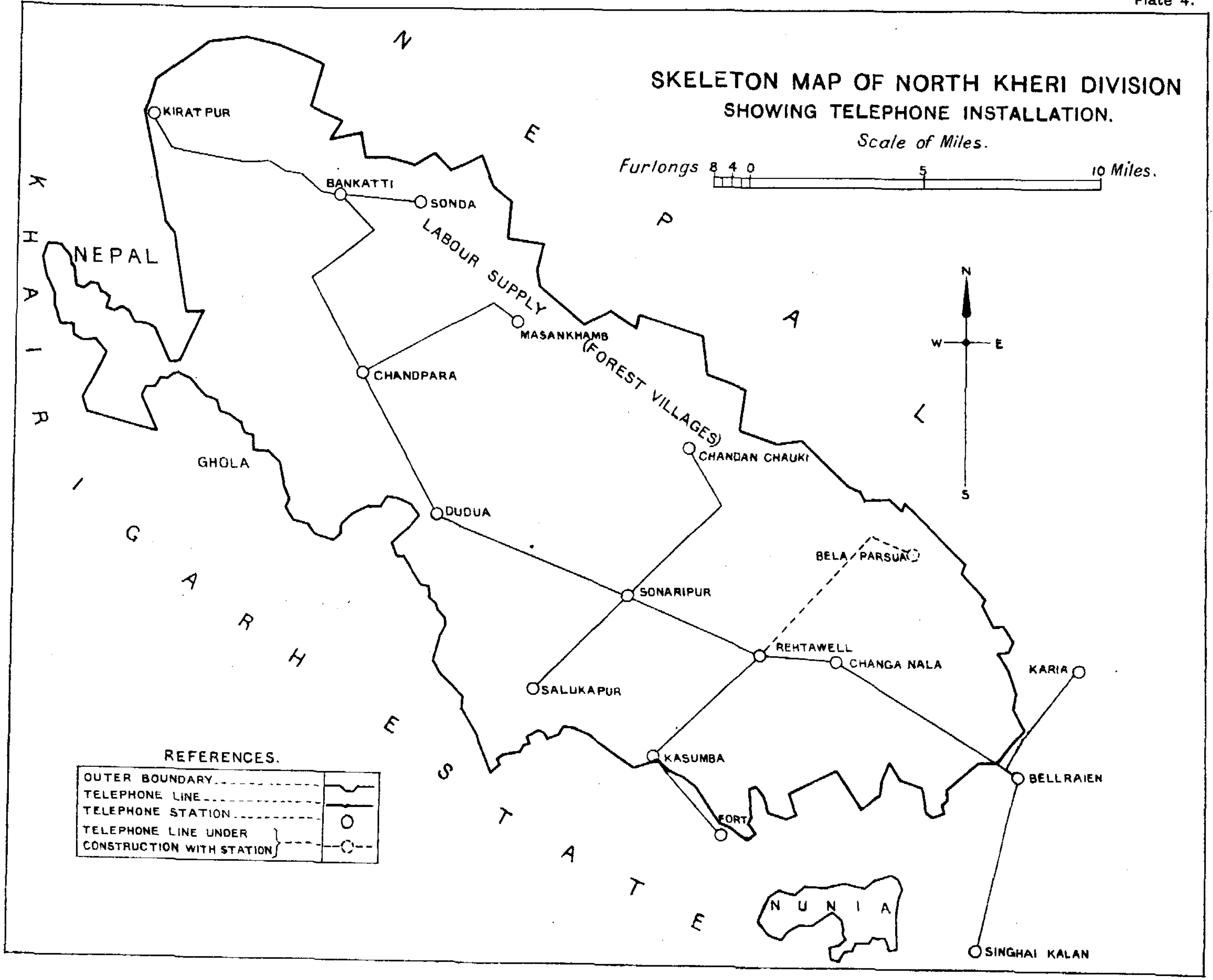
Each expedition left him poorer, and finally to meet the cost of a last effort, he mortgaged to a group of thrifty woodsmen the best portion of his forest domain. History relates that the poor Count was finally killed by the Turks, and as he left no heir, his property fell to the State. The ruler of Baden subsequently tried his best to break the mortgage lien title of the woodsmen, but his efforts were of no avail, and the forest remains to this day in their successors' hands.

These men who supplied the money for the Count to spend were known as rafters, because they put together great rafts of the largest fir timbers and floated them down the Murg, the Neckar, and the Rhine to sell in Holland, where the requirements of ship-building brought good prices This was centuries before the first idea of forest conservation had occurred to anybody, but as there was no market for anything but the largest trees, which were also accessible to the streams, the forest was not ruined.

So grew up one of the world's earliest corporations and without doubt the first commercially productive private forest which has had an uninterrupted producing record up to the present day. The ownership has remained in the hands of the descendants of those rafters, most of whom have become wealthy families and now control not only that identical forest, but as individuals and members of other companies, own and operate some of the finest saw mills, paper mills, and other wood using concerns of Germany.

The forest comprises about 12,000 acres of land similar to the Adirondack mountain region, said to be worth in the neighbourhood of $300 an acre, and there is probably almost as much timber growing on the land to-day as there was 700 years ago.

An inventory is taken of the forest every two years and the consumption of timber regulated. The amount of timber in the Black Forest is a fixed quantity and does not increase or diminish. In 50 years there will be no more or less timber in south Germany than to-day. Quite a lesson for business men over here who are paying thousands of dollars in freight bills or lumber because there are millions of acres of idle land fit for nothing but growing trees.—[*Illustrated Canadian Forestry Magazine, April 1923.*]


SKELETON MAP OF NORTH KHERI DIVISION
SHOWING TELEPHONE INSTALLATION.
Scale of Miles.
Furlongs 8 4 0
5
10 Miles.
N
W
E
S
N E P A L
K H A I R I G A R H E S T A T E
NEPAL
GHOLA
N U N I A
KIRAT PUR
BANKATTI
SONDA
LABOUR SUPPLY
MASANKHAMB
(FOREST VILLAGES)
CHANDPARA
CHANDAN CHAUKI
DUDUA
SONARIPUR
BELA
PARSUA
REHTAWELL
CHANGA NALA
SALUKAPUR
KASUMBA
FORT
KARIA
BELLRAIEN
SINGHAI KALAN
REFERENCES.
OUTER BOUNDARY
TELEPHONE LINE
TELEPHONE STATION
TELEPHONE LINE UNDER CONSTRUCTION WITH STATION

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TELEPHONY IN FORESTRY.

INTRODUCTION.

The advantages of the telephone for the purposes of the science of Forestry have long been recognised universally. But, for a variety of reasons, India, when compared with more progressive countries like the United States of America and Canada, has been conspicuously slow in erecting installations, even in those divisions which contain very valuable forests and yield a substantial sustained money return. No doubt financial stringency is partly responsible for India's backwardness; but this reason has existed only since the year 1914 when the Great War claimed practically the whole of the nation's funds and continued to absorb them up to and some time after the declaration of peace in 1919 As a consequence of war impoverishment and acute world-wide trade depression India's financial position still remains unenviable. But with the balancing of budgets, economies effected, and to be effected, by Provincial Retrenchment Committees and with intensive silvicultural management holding out the prospect of a larger forest surplus, there is light on the horizon It is, therefore, preferable to be optimistic regarding the provision of funds for forest projects in the future rather than pessimistic, since pessimism is apt to destroy enthusiasm. Prior to the year 1914 funds were certainly more readily available for useful and remunerative works, like telephone installations. It will, however, serve no usefull object here to probe deeper into the causes for the existing backwardness in telephonic communication in our forests

The aim of this article is to create enthusiasm amongst territorial Divisional Forest Officers, so that India may, as pecuniary circumstances permit, make up leeway in the interests of forestral advancement.

The telephone installation of North Kheri Division U. P.

With the exception of an isolated piece in the south the forests comprising the division are in one large compact block, the total area being 295 square miles. Like the rest of the Kheri district the country is flat. There is an excellent system of roads and fire-lines, Railway communications are unique, no part of the *sal* forests being more than six miles from a railway station. Silvicultural management is intensive. Some idea of the value of these *sal* forests will be obtained from the following figures :—

Year.	Gross Revenue. Rs.	Expenditure. Rs.	Surplus. Rs.
1920—21	11,52,057	1,20,293	10,31,764
1921—22	9,79,937	1,82,868	7,97,069
1922—23	8,68,551	1,65,222	7,03,329

In the past fires have proved very difficult to extinguish especially in the area known in the working plan recently expired as the Low Level. Here there is much grass; when a fire started it soon assumed such a wide front and travelled with such startling rapidity that enormous areas were burnt before the conflagration could be extinguished. In the south-east of the division periodical fires have had such a devastating effect that several compartments have been excluded for some years from the scheme of fellings. It is no exaggeration to relate, as far as these compartments are concerned, that the fires have all but converted what must have been once good tree-forest into grasslands. This excluded tract presents a most depressing spectacle. The history of fire-protection in North Kheri division shows that a single fire is capable of quickly traversing nearly the whole division. It was recognised that if fires were to be nipped in the bud a telephone system was essential. Accordingly, over a decade ago the Forest Department invoked the aid of the Telegraph Department and

a line approximately 11 miles in length was constructed. This modest project connected the two range headquarters at Dudwa and Bankatti at which two places telephone instruments were installed. The Telegraph Department imposed an annual charge on account of materials and maintenance. When speech was indistinct or impossible officials from that department were summoned by post from a distance to rectify defects. It was no until the year 1920-21 that a long stride forward was taken and substantial progress achieved: nearly 40 more miles of line were laid and nine more telephone stations were added. Materials of the existing line were purchased from the Telegraph Department. The Divisional Officer was responsible for this expansion and his staff maintain the whole system in a state of efficiency.

In the two following years a progressive policy was continued with the result that North Kheri division now possesses 74½ miles of telephone line and 16 telephone stations. As the map prepared to illustrate this article will show, there is at the present time a branch line under construction from Rehta Well to Bela Parsua which work should easily be completed before the end of March 1924. The division will then have 80½ miles of line and 17 stations. In addition, out of the 12 bungalows in the division no less than 10 have telephone connection, thus enabling the Divisional Officer with his portable telephone placed on his office table to be in constant communication with almost his entire charge. The branch line alluded to above will, when completed, include yet another rest house. There will then be left only one rest house to be included at some later date. All range headquarters are connected and lines have been constructed to the labour supply areas. Several excellent look-out stations have been established. In return for an undertaking to furnish men when required for fire extinguishing purposes, a telephone has been installed in the capital (Singahi) of a neighbouring *talukdar*; this arrangement clearly gives advantages to both the Forest Department and the *talukdar* who, in the absence of a telegraph line, is in telephonic communication with the nearest railway station (Bellraien).

Within reasonable limits and provided the station can serve the purpose of a look-out post this policy of a *quid pro quo* is recommended wherever possible.

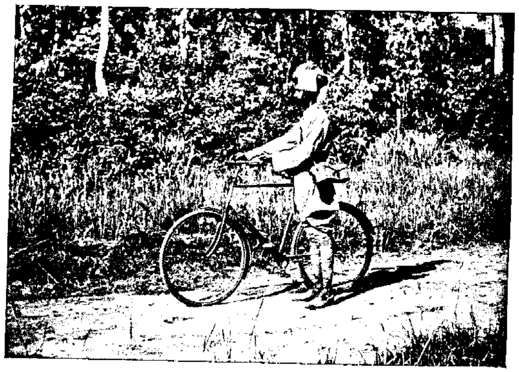
It can be asserted with much truth that the installation, through its wonderful assistance in speedily communicating the outbreak of fires and thereafter in speedily collecting labour, has paid for itself *over and over again.* To calculate the saving in terms of rupees would result at least in several tens of thousands. Fires that would have spread with a certainty and rapidity peculiar only to North Kheri division, and would have committed incalculable harm, have been attacked so quickly and with such a labour force that they have completely extinguished before they have been able to assume dangerous dimensions. The following statistics show the percentage of success achieved annually since the installation was erected :—

Year.	Percentage of success.
1920-21	99·6
1921-22	99·9
1922-23	99·9

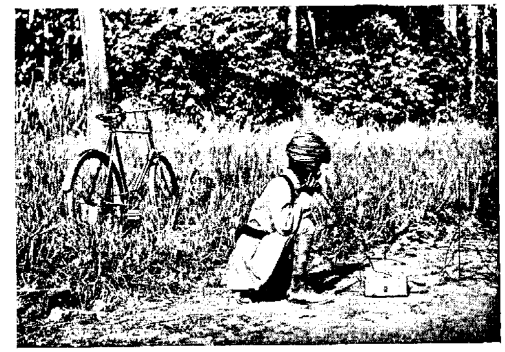
In the year prior to the installation the percentage of success was considerably lower.

An instance is remembered when a fire was observed in the south of the division, being reported at night by two look-out stations. Staff and labour were rushed to the spot and reached just in time to prevent the outbreak crossing over the boundary into *sal* forests. The fire was due to the negligence of a Forest Guard in the service of a neighbouring *talukdar ;* he had set fire to his grasslands and walked away.

On another occasion a fire was caused by a railway engine. It was a hot, dry day with a high wind blowing. The locality in which this outbreak occurred was a particularly inflammable one. The telephone installation functioned. Messages were transmitted quickly in all directions. And men cycled and ran to the spot. Within a very short time the flames were vanquished. In the absence of an installation this fire would soon have developed

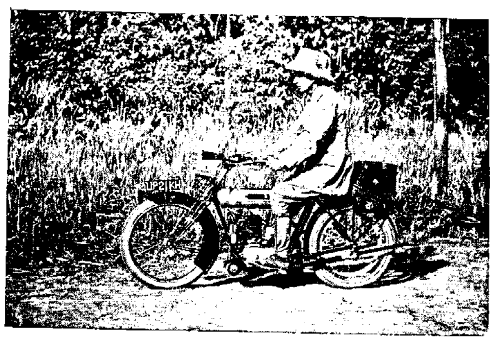


1. A cyclist-patrol of the rank of Deputy Ranger with a light portable telephone.



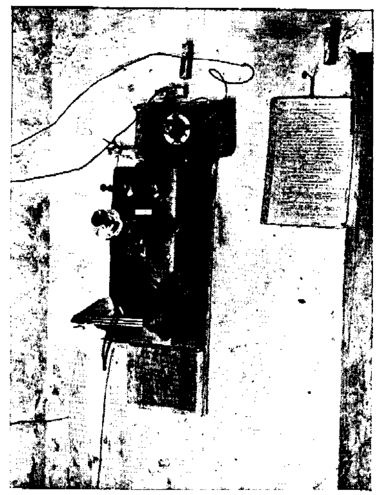
2. A cyclist-patrol tapping-in.

Note the earth-return rod in the ground a yard or two in front of him.



3. Motoring through the forests with a portable telephone on the carrier.

4. Conversing from an elephant with a portable telephone. The earth return wire is near the post.



5. Wall telephone showing lightning arrester fixed above it.

Photos by F. W. Champion, I.F.S.

an uncontrollable frontage with disastrous results. It would certainly have swept through the whole of the southern part of the division consuming at least a range. The Conservator of the Circle happened to be touring in North Kheri division at the time. His anxiety was soon allayed by a comforting message from a Range Officer who had returned from the scene of the fire that all was safe. The Conservator thus had an excellent opportunity of personally testing the efficiency of the installation. His evidence later on at a Fire-Conservancy Conference could not have been more convincing.

Several other instances could be recorded here but the above two bear sufficiently eloquent testimony to the remarkable assistance rendered by the installation.

In paragraph 14 of the Annual Progress Report of Forest Administration in the Eastern Circle, United Provinces, for the year 1922-23 the Conservator writes as follows :—

"It (the telephone system) continued to render excellent service and the fact that four fires in this division were responsible for only 21 acres being burnt is a striking tribute to the usefulness of the installation which enables an outbreak of fire to be promptly communicated, thus enabling measures to be taken before the fire gets out of control."

The telephone system has been elaborated by the institution of cyclist-patrols who carry light, portable telephones and are able to tap-in whenever necessary.

The Divisional Officer, too, can carry his portable instrument on his motor-cycle or elephant and converse from any point in the line.

The presence of an installation in a division has an excellent moral effect on the whole staff who are much more on the alert and less subject to inertia than otherwise. Men in charge of look-out stations are rung up at all hours of the day and night, and so quitting a post and departing on short leave without permission is impossible. Voices cannot be sufficiently disguised to deceive.

The installation saves a large amount of petty correspondence. References required from Range Officers are obtainable in a few minutes; thus cases are disposed of at once instead of being sent to the divisional office for additional details.

By ringing up all necessary stations at the end of the day and ascertaining progress in works, it is not only possible to keep in extremely close touch with all operations in the division but also to know precisely the movements and work of the principal subordinates during the day.

In cases of doubt Range Officers are able to ring up the Divisional Officer and solicit orders Thus in works of construction matters proceed correctly.

For the benefit of those who had no experience with telephone construction work and the planning of telephone schemes some general considerations are set forth in the following pages together with details concerning which it is essential to possess some knowledge.

Factors governing the suitability of territories for installations.

Divisions in flat country are eminently suitable, as are also those that have a main wide road or fire-line running along the foot of the hills thus furnishing the possibility of connecting all or most of the range headquarters with short branch lines to a number of rest houses. Even if certain features, physical or otherwise, render impossible a complete divisional telephone system it is, nevertheless, worth while considering the practicability of erecting installations in one, two or more ranges. For communication between a Range Officer and his subordinates, or a Range Officer and his labour supply from a fire-conservancy standpoint, is at least as important a communication between the Divisional Officer and his Range Officers. The Range Officer is the person who in the majority of cases has the direction and control of fire-extinguishing operations. In certain circumstances, such as sometimes exist in a chain of foot or outer hills, it may be found feasible to connect a range headquarters with one or more look-out stations to which the lines would run up from the

headquarters situated below. In the coniferous zone where physical obstacles are the main consideration the difficulties in laying telephone lines would naturally be very great, resulting in a correspondingly larger outlay.

In flat and gently undulating territories it is always advisable that alignments should follow fire-lines ; and if a choice has to be made between two or more fire-lines the widest should be selected provided such selection will not result in greatly increased length of wire being necessary. The laying of a line along a road fringed with tree-forest is objectionable as windfalls or falling branches will periodically snap the wire and stop communication. For this reason fire-lines are recommended. Divisions with existing well laid-out systems of fire-lines afford the greatest scope for the formulation of schemes for efficient installations.

In hilly country fire-lines usually follow ridges and spurs ; such topographical features would be selected for alignments, and schemes in territories of this description would be prepared accordingly. Generally speaking, the completion of installations in hill divisions would be slower than in plains divisions ; but there is no reason why such a natural disadvantage should be unduly discouraging.

Factors influencing the planning of installation schemes.

Firstly, the look-out stations should be most advantageously situated. In flat country it is desirable to fix stations outside the ree-forest, for from such a much larger area of the forest root is visible and rising smoke can immediately be detected. These advantages are also obtained by locating look-out posts in the middle of large internal grasslands whenever possible. Stations are more necessary in localities with bad fire histories. They are also called for in the direction of prevailing winds. In hilly tracts the selection of look-out posts presents less difficulty.

Secondly, the look-out stations should be so arranged that an incipient fire can be located by means of intersection. That is to say, the messages received from two stations should give a a fairly correct idea of the locality in which the fire has originated

Thirdly, the Range Officer should be connected directly or, if it is sometimes more economical, indirectly with all look-out stations. If possible, the Range Officer ought to be the centre of the system of lines in his range. In other words, the lines should radiate out from the range headquarters like spokes from the hub of a wheel. This arrangement is the ideal in flat country, but it will rarely be possible in the hills.

Fourthly, the Range Officer should be in communication with his main labour supply. He will then be in a position to summon all available men, directing them through the village headman to proceed to the scene of the outbreak, at the same time intimating the locality as accurately as possible so that no time may he lost in taking wrong routes. Telephonic communication with the labour supply is of the utmost importance since the early arrival of gangs at the scene of the fire is an immeasurable advantage.

Fifthly, as many rest houses and camping grounds as possible should be brought within the scheme so that the Divisional Officer may be in communication with his subordinates.

Types of construction.

Two types are possible:

(*a*) A single wire with an earth return known as a grounded circuit; and

(*b*) A double wire giving a metallic circuit.

Of the two the choice will, for forest purposes, be invariably in favour of the first since the advantages of economy and simplicity are secured without sacrificing efficiency.

In the single-wire type full advantage is taken of the conductivity of the earth for purposes of accomplishing what is known as the complete circuit. The wire forming the earth return is buried in the ground to a depth of four or five feet. With the wire it is advisable to bury a quantity of wet charcoal. In dry weather it is essential to keep the soil, in which the earth return wire is buried, moist as this procedure assists appreciably in improving the current. Water is a very efficient conductor of electricity. If wells, springs or pools are not too far off from

the stations the earth return wire should preferably be buried as near them as possible. On no account should the grounded wire or earth return be attached to any metal.

While on the subject of grounded wires it is advisable to mention that the usefulness of an installation can be enhanced by putting in grounded wires at a distance of half-a-mile apart throughout the length of the system. These grounded wires should be at posts; the latter should have a distinguishing mark or hand on each of them. The advantage of an earth return at intervals enables a cyclist-patrol or other official to tap in quickly and easily, there being no necessity of making an earth return or carrying an implement, such as a specially constructed short rod or sword, for the purpose.

Alignments.

The line should first be pegged out, a peg being placed wherever a post is to be erected. As far as practicable alignments should be straight. The larger the number of angles the longer will be the length of wire required, the greater the number of brackets and the more the expenditure on wire for stays.

It is advisable when laying out a line to see that no posts are erected too near the edge of a road, otherwise irresponsibly driven carts are apt to displace them.

If a choice has to be made between taking a line along a fire-line or through open country outside the tree-forests, it should fall on the former since it will be more useful for patrolling and tapping in purposes. It would also prove of greater use during the progress of a fire in that locality quickly to summon more labour if such was required. It would also be found advantageous when fellings take place in that particular locality. In North Kheri division, whenever feasible, a telephonic connection is given to the official in immediate charge of the fellings. He is thus able to report at once all irregularities committed by contactors.

Choice between methods of suspending the wire.

The telephone system having been planned it is necessary to decide whether the wire will be carried on wooden posts

specially cut and erected or on trees bordering the fire-line selected for the alignment. The former method is advocated for the following reasons :—

(*a*) Posts are usually plentiful in the adjoining forests and can be found *in situ*, cut, barked and erected at a small cost.

(*b*) The posts are erected along the centre of the fire-line and so carry the wire well away from trees and branches, thus minimising the damage from falling branches and trees. Consequently, the wire remains intact and interrupted communication is rare. The wire being, in the open, the line can be better seen and defects detected ; and, being on the edge of the road passing down the centre of the fire-line, is more frequently inspected. The posts take some time to erect, but this operation, if done well in advance of the wiring, forms no drawback. When the posts are once up wiring can be quickly done.

The tree method amongst broad-leaved species would not be as economical as appears at first sight. Initial economy is, however, its chief advantage. It would be necessary to send a body of men ahead to cut away branches in order to facilitate the fixing of insulators and the wiring. In coniferous forests so much branch cutting would not be necessary as the stems are usually cleaner up to the required height and straggling crowns are few and far between. In the case of a fire the line suspended on trees would be liable to more damage than that running along the middle of a fire-line. Briefly, then, the tree method would be somewhat cheaper in the beginning but is apt to be more expensive in maintenance and less free of trouble during the life of the line.

Specification for and erection of posts.

In North Kheri division the species utilised for posts is *sal* and they last from eight to ten years. They are usually placed 100 yards apart in the line, except when ascending or descending

natural obstacles. They should be as straight as possible and should be barked at once after cutting. Their diameter, under bark, at breast height, should be approximately eight inches and their usual length about 20 feet of which four feet go under ground. That is to say, the height of the wire above the ground level will be 16 feet. There are, however, special cases in which longer posts are necessary. When it is required to cross over a railway line the wire must be at least 20 feet above rail level. Such a crossing requires specially tall poles, the height being calculated with reference to the height of the railway enbankment and other circumstances governing the particular case. At least one-fifth of the length of the pole should always be buried in the ground. It should be seen that the posts are placed sufficiently far from the railway line so that in case the posts fall at any time they will not lie across the rails. When crossing over a telegraph line the telephone wire should be carried at least two feet above it. Accordingly, for such crossings posts of special height will be necessary. In rest house compounds in divisions where elephants are used the wire should be at least 20 feet above ground level; therefore, posts 25 feet long should be cut; this arrangement affords ample room for elephants with howdahs to pass under the wire. An important point to remember in undulating country or where a post must be erected in a sudden depression is that the height should be such as to compensate for the depression, so that the wire will continue in its horizontal plane of 16 feet above ground level. If the post in the depression is lower than its neighbours there is an undue strain on the insulator fixed to it; the resultant of the forces being upwards either the insulator breaks eventually or is raised bodily from the post and left *en l'air*. When ascending or descending a high bank or similar obstacle the heights of the posts should be carefully graduated so that the wire will, when the line is completed, lie with a gentle rise or fall respectively; there should be no sudden ups and downs, otherwise the insulators will not bear the unequal strain.

In flat country where the ground is not rocky earth augers are useful for making holes for the posts. These implements make

holes of uniform diameter and depth and more expeditiously and neatly than men working with ordinary tools. The size of auger recommended is one ten inches in diameter, that is to say, it will make a hole of that diameter. One man can handle the auger and make several holes in a day. These earth augers are obtainable from any of the large hardware firms in Calcutta.

It is, perhaps, unnecessary to add that it is a sound plan to coat with coal tar all that portion of the post to be buried in the ground and to extend this treatment a foot above ground.

At a range headquarters where several wires are likely to be carried by a single post the latter should be about ten inches in diameter, under bark, at breast height, as greater strength will be required.

As a preservative measure before erecting posts the heads should be gently trimmed away towards the perimeter, thus enabling rain and dew water to run off. While this trimming operation is being done the holes to receive the insulator stalks should be bored and the stalks themselves driven in. With the stalks are supplied washers ; these should be placed above the holes in the heads of the posts and the stalks driven through them. If thus utilised they serve as protective caps and assist in preventing water from finding its way in between the stalks and the sides of the holes. These preservative steps appear petty, but they all function towards assisting the stalks to maintain a tight grip in the head of the post which they can only do so long as the timber remains sound.

Insulators.

In order that the current may be continuous, namely, that the wire or conductor may not have the smallest break in its metallic continuity, the line is suspended on insulators of porcelain. These insulators are shaped like inverted cups having one or more grooves round them. They are provided with an internal screw thread to fit the top of the bolt or stalk which is fastened to the post either by means of a bracket or, for the sake of economy, is itself driven into the head of the post.

In erecting the line the wire is first stretched conveniently tight over several poles. It is next placed in one of the grooves of the insulators and secured in position by binding wire: thus at the insulators there is no break in the continuity of the conducting wire.

There are many patterns and sizes of porcelain insulators on the market. Two have been found very suitable for forest purposes. These are the Sinclair insulator and Siemen's No. 38. For very short spans of 30 feet or so to range headquarters, Forest guards' chawkis and rest houses the Swan Neck insulator, which is smaller than the two mentioned above, will be found useful.

The Sinclair insulator has a bolt or stalk that is designed for insertion in a bracket. But brackets are unnecessary where the line is straight. Consequently, as a measure of economy during the erection of the North Kheri installation, brackets were dispensed with. The stalks of the insulators were pointed at the lower ends by local blacksmiths and then driven into the tops of the posts, care being taken not to disturb the threaded heads of the stalks as these latter receive and hold the insulators. Before driving the stalks into the tops of the posts it is advisable to bore shallow holes for them as this plan prevents excessive splitting of the posts. These Sinclair insulators have given excellent service.

Siemen's No. 38 is heavier and stronger than the Sinclair insulator. It is useful at angles in the alignment. Experience has shown that the stalks of Sinclair insulators are soft and bend at angles. Sound construction at angles can be accomplished by the use of Siemen's No. 38 inserted in a metal bracket fastened by bolts and nuts to the post.

When providing a connection to a building the strain of the last span of wire should be taken by a post erected as near the building as possible. From this post the wire can be taken in with the assistance of a Swan Neck insulator fixed to the eavesboard or a rafter or the frame of a door or window. If such a post is not erected and the weight of the final span is supported by an insulator fixed to the building a continual and disturbing buzzing

sound, caused by play on the wire by the wind, will be heard. This sound is louder and more disturbing where buildings stand in exposed positions.

Wire.

For very long distance communication, for example, between Lucknow and Naini Tal, about 263 miles, copper wire is employed by the Telegraph Department. In North Kheri division where the greatest distance between any two stations is approximately 41 miles, galvanised iron wire 9 B. W. G. has been found very efficient. The latter is much more economical and will, it is believed, be found generally suitable for forest installations. It is essential to procure fresh wire as such will, of course, render better service than old material. It is advisable, if time permits, to place an order with one of the large and reliable firms in Calcutta or Bombay and to ask that the wire be specially ordered from the manufacturers in England and supplied immediately on the consignment being received. The above advantageous procedure will not be possible in the case of those Divisional Officers who are now held in bondage by *dicta* of a Stores Purchase Officer.

Approximately 713 yards of No. 9 B. W. G. galvanised iron wire weigh 1 cwt. In an ordinary coil there are from 800 to 900 yards. Each coil or bundle should be wrapped in *gunni* cloth by the supplying firm prior to despatch :—

Wiring.

Before wiring can be begun it is necessary to have the following materials and implements. It is presumed that the insulators have already been fixed in position on the post.

Materials.

Line wire ...	... About two coils suffice for a mile.
Binding wire ...	... 14 B. W. G. galvanised iron wire is suitable and a quarter of a coil suffices for five miles. This wire is cut into lengths of 1½'.

Stay wire ...	... Ordinary strand fencing wire serves the purpose, aud ordinarily half a coil will be found enough for five miles.
Solder ...	... A small quantity.
Nausadar (Sal-ammoniac)	... A small quantity.

Implements.

A large reel ...	... A coil of wire is placed on this and unwound as required. The reel is made and fixed to a wooden platform to which there are handles in front and behind to enable two men to carry it. In the upper part of the reel there are three or four holes round the circumference into which wedges are fixed to keep the coil of wire in position.
Wire-cutting pliers	... Two will be required.
Manilla rope ...	... Five pieces, each 5′ long and 1½″ diameter. Also a long rope 100′ long and 1″ diameter.
Pulleys ...	... Two small pulleys with hooks.
Lineman's vise (for making wire joints).	One.
Eye bolt ...	... One.
Triangular file ...	... One.
Soldering iron ...	... One.
Axe ...	... One.
Adjustable wrench	... One.
Bracket wrench ...	... One.
Hammer ...	... One.

Chagal—(large water bottle) ... One.
filled with water.

Ladders ... .. Three are required, two will each be 20′ long and the third 25′ long. They should be as light and portable as possible.

There are four distinct operations in wiring :—

(*a*) spreading the wire,
(*b*) raising the wire,
(*c*) tightening the wire, and
(*d*) fastening the wire to the insulators.

(*a*) Having taken off the *gunni* wrapping and cut the thin wire binders that hold the coils together, the bundle of wire should be placed in a horizontal position on the ground and the inner end and outer end found. Then the coil should be lifted carefully and put on the pay-out reel with the outer end upwards. Next the plugs should be fixed in the holes of the reel. These plugs prevent the coil from coming off the reel during the process of paying-out or unwinding. Having fixed the plugs a piece of rope 5′ long is taken and one of its ends is intertwined with the outer wire end, the latter afterwards being turned back to give the rope a secure hold on the wire. The pay-out reel is then carried to the terminal post. The free end of the rope is next given to a small gang of men who walk slowly forward along the line of posts. Thus the coil is unwound and the wire laid out on the ground preparatory to raising. During paying-out one or two men should remain at the reel to replace the plugs if they come out. It is important to keep the coil in its correct position on the reel. So long as this is done the operations of paying-out and spreading the wire will proceed smoothly. When the coil is completely unwound the men at the reel signal to those ahead to stop. The end of the wire at the terminal post, where the reel is, should then be raised and fastened to that post's insulator.

(*b*) Raising the wire is done by a man taking the line wire in his hand, ascending a ladder and placing the wire on the tops of the posts and touching the insulator stalks. He next takes a

piece of binding wire, $1\frac{1}{2}'$ long, and places it in the lower grooves of the insulators drawing the ends equally towards him. The end in his right hand he turns to the left and *vice versâ.* Thus a twist is formed on which the line wire is placed. The ends of the binding wire are then turned away backwards which step holds up the line wire. The binding wire is next given a twist on the outer side of the insulators, the ends brought forward under the line wire and then turned upwards in which position they remain until the line wire has been finally made taut.

(*c*) Tightening the wire is effected by means of two pulley blocks. About 20′ from the post near which the forward end of the wire has reached a loop is tied in the line wire with the assistance of a rope 5′ long. Into this loop the hook of one of the pulley blocks is fixed. With the help of another piece of rope of similar length the second pulley block is fastened at a point $2\frac{1}{2}'$ above the ground to the post near the end of the line wire. Then a rope 100′ long is taken and made to pass through the grooves of both pulley blocks. The end of this long rope is then gripped by several men and pulled slowly and steadily. Pulling spasmodically or in jerks harms the insulators. When the wire has been sufficiently tightened the long rope is tied to the post that holds the pulley block. The wire is considered sufficiently tight when there is a sag of about 9″ in a span of 100 yards.

(*d*) Fastening the wire to the insulator is done by taking hold of the two ends of the binding wire turned upwards and winding each end round the line wire six or seven times on either side of the insulator, any spare binding wire being cut off with pliers.

The joining of the end of one coil with the end of another coil of line wire is important. The two ends are taken and made to overlap about 12″. The centre of the overlap is held securely by an implement known as a lineman's vise. Then the end of each wire is twisted tightly about six times round the other wire. Finally, the whole joint is very carefully soldered throughout its length after the loose ends of the wires have been neatly filed down. Soldering ensures that there will be no leakage of the current. It must be emphasised that it is of the utmost

importance that these wire joints should be thoroughly efficient electrically and mechanically.

STAYS.

Stays are wire struts supporting terminal posts, posts at angles and also those posts at points where the line wire crosses a railway line. Stays should be constructed before the operation of tightening the line wire is carried out. The height of the post to be supported should be ascertained and three-fourths of the height will give the distance at which the strut should be anchored. The stay should always be in the opposite direction to which the post displays a tendency to fall. As a rule one stay suffices, but occasionally two are necessary. At railway crossings each post must be given three stays as a special case. At the point of anchorage a pit $5' \times 2\frac{1}{2}' \times 4'$ should be dug. A depth of $4'$ is an average dimension; the greater the angle in the alignment the deeper should be the pit up to a maximum of $5'$. About $12''$ from the top of the post the stay wire should be wound round tightly four or five times and the ends of this wire fixed to one of the ends of a union screw which should be previously unscrewed to its maximum amount of play. Next, a long piece of stay wire should be fastened to the lower loop of the union screw and measured as far as the bottom of the pit. This length *plus* $5'$ will give the correct length of stay wire required. In order to make the anchor, five sound kiln-burnt bricks or suitably shaped stones of equivalent weight should be taken and arranged in three tiers, the two bricks of the lowest tier being laid flat, the next two superimposed on them and the fifth brick laid so as to break bond. The additional $5'$ length of wire should be taken, passed under the lowest tier and tied to bind all the bricks firmly together. The bricks should then be let down into the pit, but in such a manner that when the stay wire is fully stretched they should be suspended and about $6''$ from the bottom of the pit. Two men should now stand on the bricks and with several jerky motions of their bodies endeavour to weigh the bricks down to the base of the pit. This step results in bringing the post slightly towards the anchorage to counter-effect the strain of the line wire. Earth is

then well rammed into the pit, the bricks thus being made quite firm.

It is always advisable to use either bricks or stone, as a log of wood would perish sooner or later and the post would fall.

If subsequently the post shows signs of inclining away from the anchorage it can be straightened by tightening the union screw, sufficient scope for this purpose already having been left.

TYPES OF TELEPHONES.

Three types of magneto telephones are necessary in a divisional installation :—

(*a*) Wall telephones,
(*b*) Portable desk telephones,
(*c*) Light portable telephones for patrols.

(*a*) Wall telephones : The model tried and found very efficient is No. 1317P manufactured by the Western Electric Company, New York, U.S.A. whose agents in India are Messrs. Josts Engineering Company, Electrical Engineers, Bombay. The makers claim that the No. 1317P wall type magneto telephone *represents the highest development yet attained in magneto telephone design and construction.* The instrument is certainly simple and compact and is obviously built for rough wear. Dry batteries are used. Two cells suffice for each instrument. The cell recommended is the Dry, Inert Cell P size obtainable from the Controller, Government Telegraph Stores, Alipur, Calcutta. If Dry, Inert Cells are not readily obtainable then the Western Electric Company's Blue Bell Cell will be found suitable. These Blue Bell Cells are expressly designed for long distance work.

(*b*) Portable desk telephones: The model pre-eminently suitable for the use of a Divisional Officer is Ericsson's Portable Set. This instrument is constructed by the British L. M. Ericsson Mfg. Co., Ltd., 60, Lincoln's Inn Fields, London, W. C. 2, England. It is contained in a well finished wooden box measuring 12″ × 6¼″ × 8¼″ and weighing 17 lbs. It takes two dry cells P. size. It is specially made for the Indian climate and has that excellent finish for which British instruments are so justly famous. This telephone is obtainable from the

Controller, Government Telegraph Stores, Alipur, Calcutta It can be placed on an office table within arm's length in which position it can be used very conveniently. It is possible to carry this telephone on the carrier of a motor-cycle. It would of course easily go into a side-car.

(*c*) Light portable telephone for patrols: The instrument found useful is the Peel-Connor field service pattern magneto call telephone in leather case with sling. It measures 10" × 5" × $3\frac{3}{4}$" and weighs 12 lbs. The ringing is effected by means of a buzzer. This model is procurable from the General Electric Company, 14, Old Court House Street, Calcutta, who are the agents of the manufacturers, the Peel-Connor Telephone Works, Stoke, Coventry, England. The cells used with this portable instrument are of a special size, and, therefore, obtainable only from the agents. When tired of carrying these instruments cyclist-patrols can strap them to their back-carriers.

A special contrivance known as a Lightning Arrester should be attached to each of the wall telephones. This precaution preserves the instruments which are apt to be damaged when the atmosphere is heavily charged by strong or abnormal currents of electricity. In the construction of these arresters full advantage is taken of the properties of mica.

Switch-boards.

In the year 1920-21 when the telephone system was installed in North Kheri division switch-boards were erected at each of the range headquarters and tried. But it was soon found that so many were the calls in the ordinary course of business during the day that a whole-time man would be necessary to operate them. Range Clerks were at first deputed to work the switch-boards in addition to their ordinary duties, but there was a unanimous complaint that the switch-boards involved constant interruption in clerical work Moreover, the switch-boards threatened to be defective and too technical to be easily repaired in the forests. On the above disadvantages appearing it was decided to have a simple, straight forward system without switch-boards, and to work on the basis of a different call for each

station. This system is free of complications and the experience of the last three years has proved it to be the best and most economical in the absence of a highly technical telephone staff. To illustrate precisely what is meant by the above, the distinguishing calls for the several stations, during the fire-season of 1922-23, are given below together with a few simple instructions in force. A copy of these calls and rules is hung up at each station in English and the Vernacular :—

NORTH KHERI DIVISION.

TELEPHONE INSTALLATION.

The following are calls for different stations :—

Divisional Forest Officer	... one short ring.
Kiratpur ...	... one short ring and one long.
Bankatti	... one long ring.
Chandpara ...	... two short and one long ring.
Masankhamb ...	... one long and two short.
Dudwa ...	... two short.
Sonaripur ...	.. three short.
Chandan Chauki...	.. three short and one long.
Salukapur ...	.. one long and three short.
Lauki dagra ...	... three short and two long.
Kasumbha ...	... two long and three short.
Rehta ...	... one long and four short.
Changa Nala ..	... four short and one long.
Bellraien ...	... four short.
Fort	... one long and five short.
Singahi ...	... five short.

NOTE :—Telephones will be temporarily installed at Chandpara and Rehta Well, being removed on receipt of orders to Sonda and Karia.

The following rules should be followed :—

1. Do not use the telephone when there is lightning.
2. Water the earth return once a week with about two or three gallons of water.

3. When you wish to converse you should first take up the receiver and listen if a conversation is in progress. If not, replace receiver and ring up your station. If your business is urgent ask for the conversation to be terminated. Then ring up the station you require.
4. Always replace the receiver on the hook after use.
5. Always use two cells with each telephone.
6. When a Range Clerk leaves the range office he should post a man there to listen to calls during his absence. The larger the number of subordinates acquainted with a telephone for conversing purposes the better.
7. During the fire-season a subordinate should sleep at night in the range office in order to receive calls.

NOTE :—An Urdu translation of these instructions should be posted up near each telephone.

Under this system the official in charge of a station knows his own particular call and answers when he alone is rung up. Even the illiterate fire-watcher on Rs. 9 per mensem soon learns his own call as well as that of the range headquarters station to which he is subordinate and so becomes a useful operator.

Faults.

Every Divisional Officer whose division has, or is about to have, a telephone installation should equip himself with a pocket book published by the Telegraph Engineering branch of the Posts and Telegraphs Department of the Government of India. This book enumerates the faults commonly met with in telephone apparatus and describes how they can be rectified. Its title is "Wiring Diagrams of Telephone Apparatus and Faults in Telephone Apparatus" It is printed in Calcutta by the Superintendent, Government Printing, India. This pocket book is as indispensable to a Divisional Officer responsible for a telephonic installation as is the Ford Manual to the isolated owner of a Ford motor car.

Cost of construction.

The following estimate for a telephone installation 50 miles long will be found useful. It is for conditions obtaining in flat

country For hilly territories the cost of certain items would have to be enhanced to cover the cost of extra carriage:—

Serial No. of item.	Particulars.	Amount.	Total of sub-head.
		Rs. a. p.	Rs. a p.
	(*a*) *Instruments.*		
1	10 Wall Telephones @ Rs. 200 each. ...	2,000 0 0	...
2	20 Inert cells (2 for each telephone @ Rs. 3 each)	60 0 0	...
3	100 Lead-in-wire (10' for each telephone) @ Rs. 40 per 100'	40 0 0	...
4	1 Portable Table Telephone (for Divisional Forest Officers) @ Rs. 70	70 0 0	...
5	2 Inert cells @ Rs. 3 each	6 0 0	...
6	20 yards cable wire @ Rs. 20 per 100 yards ...	4 0 0	...
7	4 Portable Telephones (for cyclist-patrols) @ Rs. 120 each	480 0 0	...
8	80 yards cable wire (20 yards for each portable telephone) @ Rs. 20 per 100 yards ...	16 0 0	...
9	8 Inert cells (2 for each telephone) @ Rs. 3 each	24 0 0	...
10	10 Lightning Arresters (one for each wall Telephone) @ Rs 5 each	50 0 0	2,750 1 0
	(*b*) *Line materials.*		
1	Telephone line wire No. 9 S. W. G. 6 tons, 3 cwt 2 qrs. 21 lbs including 1 qr. for earth returns and sagging @ Rs. 27 per cwt.	3,332 0 0	...
2	Binding wire No. 14, 45 lbs. including 11 lbs. for leading connections on each telephone station @ Rs. 48 per cwt.	19 4 6	...
3	Stay wire 920 yards, *i.e.*, 3 Cwts. including stays at Rly. crossings and helping posts @ Rs. 42 per cwt —Rs. 126 ... ... 80 galvanised union screws ½" diameter @ Rs. 4 each—Rs 320 ... ... 80 brackets @ Rs. 2-8 each—Rs. 200 ...	646 0 0	...
4	Freight on telephones, binding and stay wires @ Rs. 10 per mile	500 0 0	...
5	864 Sinclair insulators (including 14 extra for breakages) with bolts, washers and nuts @ Rs. 18 per dozen	1,296 0 0	...
6	Freight on the above, union screws, brackets, cells, etc. @ Rs 5 per mile	250 0 0	...
7	2 dozen Swan Neck Insulators @ Rs. 9 per dozen	18 0 0	...
8	4 dozen cleats (small insulators) @ 8 as. per dozen	2 0 0	...
9	Telephone tools and apparatus	260 0 0	6,324 1 6

Serial No. of item.	Particulars.	Amount.	Total of sub-head.
		Rs. a. p.	Rs. a. p.
	(c) Installation.		
1	Cutting, barking, carting, boring holes in the ground and fixing 900 posts @ 8 as. each ...	450 0 0	...
2	Point-making of 864 stalks, boring holes and fixing them in posts @ 1 as. each ...	54 0 0	...
3	Coal-tarring the posts :— Coal-tar 25 tins @ Rs. 4 each tin—Rs. 100 Kerosene oil 6 tins @ Rs 5-2 0 each—Rs. 30-12 Labour charges for 50 coolies @ 8 as. each—Rs. 25	155 12 0	...
4	Alignment of the telephone line @ Rs. 5 per mile for 50 miles	250 0 0	...
5	Charges for stretching line wire, etc., @ Rs. 6-12 per mile	337 8 0	...
6	Carting of line wire, tools, apparatus, etc., @ Rs. 2 per mile	100 0 0	...
7	Resin core solder, in sticks	25 0 0	
8	Nausadar (Sal-ammoniac or Ammonium Chloride)	6 4 0	...
9	Miscellaneous	47 6 6	
			1,425 14 6
	GRAND TOTAL ...	...	10,500 0 0

Thus the cost of construction per mile in flat country is Rs. 210

Cost of maintenance.

In order to arrive at a reliable figure regarding cost of maintenance per mile per annum the Divisional Cash Book has been carefully consulted, under the budget sub-head concerned (A VIII f), for the period from the 1st April 1922 to the 31st March 1923, *i.e.*, one complete forest or financial year. The actuals are made up of a number of items; these have been brought together according to the following classifications :—

		Rs. a. p.
1. Repairs to telephone lines ...	...	155 7 0
2. Cost of telephone material for repairs	...	43 15 9
3. Railway freight and cartage ...	...	29 4 0

	Rs.	a.	p.
4. Cost of telephone cells (with railway freight)	176	9	7
5. Repairs to telephone instruments by Messrs. Josts' Engineering Co. (with railway freight)	104	0	0
6. Erection of three look-out station (huts) at Kiratpur, Sonda and Salukapur ...	28	0	0
7. One-third pay of a Deputy Ranger occasionally on special telephone duty ...	240	0	0
Total ...	777	13	4

The telephone installation covers $74\frac{1}{4}$ miles, and thus the annual cost of maintenance per mile per annum is only Rs. 10-7-0, a remarkably low figure.

It will be of interest to add that when the Dudwa-Bankatti line, 11 miles long with two telephones, was maintained for the Forest Department *by the Telegraph Department the total* annual charge imposed was Rs. 296 ; so that the cost of maintenance per mile per annum was Rs. 26-14-6, *i.e.* about $2\frac{1}{2}$ times the present figure. For the sake of economy, therefore, it is advisable for Divisional Officers to maintain their own installations.

To those Divisional Officers who, in consequence of a small annual surplus, may view with some alarm an annual recurring expenditure of Rs. 10-7-0 per mile per annum, it is necessary to point out that an installation should automatically result in an appreciable reduction in the number of fire-watchers and fire-patrols ; also in the abandonment of certain fire-lines that will be rendered obsolete by the introduction of a more efficient means of communication. It is thus very meet and right to weigh the precise extent of these annual savings against the estimated annual recurring cost of an installation when submitting a scheme for sanction

Tools required.

A list of tools, with approximate prices, necessary for a telephone installation is given below :—

Serial No. of item.	No. required.	Description of tools.		Approximate price.	
			Rs.	a.	p
1	4	Earth augers (10" diameter) @ Rs. 12-8 each ...	50	0	0
2	4	Axes @ Re. 1 8 each	6	0	0
3	4	Spades @ Rs. 2 each	8	0	0
4	1	Billhook @ Rs. 5	5	0	0
5	1	Ball bearing pay-out reel @ Rs. 50	50	0	0
6	4	Double block pulleys (3½" diameter) @ Rs. 12-8 each	50	0	0
7	1	Hand hammer @ Rs 3	3	0	0
8	1	Lineman's vise @ Rs. 6 8...	6	8	0
9	1	Binding tool @ Rs. 3	3	0	0
10	1	Eye bolt @ Rs 4 8	4	8	0
11	2	Wire cutting pliers @ Rs. 4 each	8	0	0
12	1	Soldering furnace @ Rs. 6	6	0	0
13	1	Soldering bolt @ Rs. 4 8	4	8	0
14	2	Files (one flat and one triangular) @ Rs. 1-4 ...	2	8	0
15	1	Adjustable wrench (spanner) @ Rs. 7-8 ...	7	8	0
16	1	Hammer wrench @ Rs. 6	6	0	0
17	1	Bracket wrench @ Rs. 5-8	5	8	0
18	3	Screw drivers (one small, one medium and one big)	4	8	0
19	1	Knife @ Rs. 3	3	0	0
20	1	Chisel @ Re 1 8	1	8	0
21	1	Tree-trimmer @ Rs. 3-4	3	4	0
22	1	Tool-bag @ Rs. 21	21	0	0
		Total ..	259	4	0

Conclusion.

It is possible, if time permitted, to write at greater length on this interesting and distinctly practical subject of Telephony in Forestry, but it is hoped that the foregoing article will suffice to assist territorial Divisional Officers to plan and erect installations.

With the rapid development of wireless telegraphy and the manufacture of reasonably priced wireless sets it may be possible in the near future for Divisonal Officers to consider the erection of wireless installation. In some localities it is probable that the erection of such installation would be more economical than systems based on telephony ; while in others the latter, on account

of their simplicity and lower construction costs, would be preferable to the former. A service based on aeroplanes would be more expensive than a telephone system and of less general use than the latter.

The recent silvicultural awakening, the increasing desire for intensive silvicultural management and the consequent application of well-defined and advanced scientific method of treatment—such as the Shelterwood System and its modifications under which the successful protection from fire of a crop in its early and non-fire-resistant stages is a *sine qua non*—make immediately and abundantly manifest the necessity for introducting modern means of certain and speedy communication.

No installation, no matter what its specification or nature may be, can prevent fires from breaking out in our forests. But we know that it can help in telling us when and where the outbreak has occurred and in assisting us expeditiously to gather men and materials at the site, so enabling us to give timely battle against the flames and to prevent the fire from developing into a veritable conflagration with that dreaded feature—an uncontrollable frontage.

Let us, then, realise more in the future than we have in the past the profound wisdom in the peculiarly apt lines of the immortal Shakespeare :

> "A little fire is quickly trodden out,
> Which, being suffered, rivers cannot quench."

J. E. C. TURNER, I.F.S.

NOTE ON THE PARASITIC FUNGUS, *PERIDERMIUM*.

In the April and May 1922 numbers of the *Indian Forester*, a note was published by the undersigned on the death of *chir* pine poles in the Almora plantations of Kumaon. The conclusion reached (p. 237) was that the parasitic fungus, *Peridermium complanatum* var. *corticola* of Barclay, was the primary cause of the heavy mortality recorded, and some account of this fungus is

given (pp. 171—174), including a surmise that *Cratægus crenulata* or *Rosa moschata* might prove to be the alternate host carrying the uredo and teleuto stages.

I have recently received a communication from Dr. Geo. G. Hedgcock, Pathologist, Bureau of Plant Injury, U. S. Dept. Agric., in the course of which he makes some suggestions which should be of interest to those of us who have to deal with *chir* forests. Dr. Hedgcock is of course himself responsible for a very large share of the advance which has been made in the study of these rusts attacking conifers, and he has kindly sent me separata of several of his published papers on them from which, with his letter, I have put together the following summary showing the present situation with regard to the corticolous species of *Peridermium*,* as reached in the U. S. A. It will be noted that the regret previously expressed (*loc., cit.* p. 171) concerning inability to obtain access to the literature still applies, and is the reason why even now, European studies cannot be dealt with.

At least six species of *Peridermium*, like that on *Pinus longifolia*, are known in the U. S. A. to infest the stems and branches of pines and the life history of each of them is known, the identity of the æcidial stages on the pines with the uredo and teleuto stages on other plants having been amply demonstrated by inoculation experiments on a conclusive scale. These species are described on the nest page.

The general life history may be repeated for a typical species (*P. pyriforme*). The æcidia on the pine mature at the end of May, the discharge of the spores lasting about a week, being especially active during the first day or two after opening. The leaves of the broad-leaved host are infected within a radius of about 200′ from the typically small pine, and uredospores are produced in 8 to 10 days, infecting further plants through as many as six or more generations, spreading very rapidly. Some 15 days after the shedding of the uredospores begins, telia are produced

* The name *Peridermium* is used throughout this note for the æcidial stage parasitic on pines, as it is well known to foresters, and naturally is used in most of the older literature: the convention among mycologists is to accept the generic name of the uredo and teleuto stages as that proper for the fungus in all its stages, with the specific name first used for any stage.

Aecidial Stage. (*Peridermium*).	Chief Host. (*Pinus*).	Uredo stage (*Cronartium*).	Chief Host.	Natural Order of host.	Notes.
P. pyriforme ...	*P. rigida* ...	*C. pyriforme* ...	*Comandra* ...	*Santalaceæ* ...	Named from the unusual shape of the æcidiospores.
	P. ponderosa ...				
P. cerebrum ...	*P. contorta* ...	*C. cerebrum* ...	*Quercus* ...	*Querciflora* ...	Forms galls on pines.
(= *P. Harknessii*) ...			*Castanopsis* ...	*Do.* ...	
P. comptoniæ ...	*P. rigida* ...	*C. comptoniae* ...	*Comptonia* ...	*Myricaceæ* ...	
			Myrica gale ...	*Do.* ...	
P. filamentosum ...	*P. ponderosa* ...	*C. filamentosum* ...	*Castilleja* ...	*Scrophulariaceæ* ...	
	P. contorta ...		*Pedicularis* ...	*Do.* ...	
P. strobi ...	*P. strobus* ...	*C. ribicola* ...	*Ribes nigrum* ...	*Saxifragaceæ* ...	Introduced into and exceedingly destructive in U.S.A.
P. occidentale ...	*P. edulis* ...	*C. occidentale* ...	*R. aurem* ...	*Do.* ...	Does not kill the pines.

from the same sori, and germinating *in situ* produce a besidium bearing four or less minute sporidia which are readily blown away to infect new pine hosts. Infection of pines can apparently only take place through young growing tissues, especially those over a wound, the period of infection being thus somewhat restricted. As a rule, only small trees are attacked, and attack is for most species typically fatal, killing off 50% or more of the plants in heavy infestations.

Most of the species of *Peridermium* attack several species of pine, and more than one species may occur on a given pine species. Similarly the uredo stage can usually infect a variety of species of one host genus or even several allied genera, and one host species (as *Ribes aureum*) may be attacked by more than one species of *Cronartium*. Direct infection of pines by æcidiospores has been effected in the case of *P. strobi* and *P. Harknessii* but does not appear to take place at all readily. In the case of *Cronartium cerebrum*, it appears that the fungus may pass through the winter in the leaves of the host, in this case evergreen oaks. The effect of the attack of the fungus on the coniferous host varies with the species and the conditions ; there may be regular spherical galls, more or less convoluted as the name " cerebrum " suggests, or fusiform swellings as sometimes seen in the case of *Pinus longifolia*, or there may be no visible hypertrophy ; resinous bleeding is very usual.

All the corticolous species of *Peridermium* are thus seen to be the aecidial stages of species of *Cronartium* parasitic on trees, shrubs and herbs belonging to a variety of natural orders. As far as I am aware, no species of *Cronartium* has yet been described from India. Dr. Hedgcock points out that the alternate host of our species is not likely to be either *Rosa*, which more usually carries *Phragmidium*, or *Crataegus*, which is the usual host for the well-known *Gymnosporangium* of junipers. The suggestion had no further basis than the present writer's inability to find any other frequent plant common to all the localities of heavy infestation and still appears probable. *Quercus* is virtually absent from several centres of the fungus attack.

As regards the acicolous species of *Peridermium*, many of them have been correlated with species of *Coleosporium* producing uredia and telia on a variety of herbaceous plants especially *Compositæ*, genera occurring in the Himalaya being *Sonchus*, *Solidago*, *Inula* *Tussilago*, *Vernonia*, etc.; other host genera are *Campanula*, *Melampyrum*, *Ipomœa*, *Convolvulus* and *Ribes*. Barclay has recorded three species from India, on *Campanula colorata*, *Clematis montana* and *Plectranthus Gerardianus*, but none of these three plants suggest themselves as probable hosts for the common needle rust of *Pinus longifolia*, though the last two might serve for that of *Pinus excelsa*. Infection of the pine with sporidia from teleutospores on the broad-leaved host in the autumn, usually results in the production of æcidia in the following spring.

A third interesting group of species of *Peridermium* is found on the cones of pines, in which they cause considerable hypertrophy and complete destruction of the seed. Two such have been studied by Dr. Hedgcock and his collaborators, who have proved their connection with species of *Cronartium* (*Cæoma*) on oaks and chestnut. I am not aware that any allied form has as yet been recorded from India.

H. G. CHAMPION, I.F.S.

[Since submitting this note for publication the writer has received a valuable collection of material of the American species mentioned, which may be seen on application by anyone interested in these fungi.]

ESTIMATES FOR AUCTION SALES.

When conditions permit of the outright sale of trees by public auction, that is undoubtedly the ideal method of disposal. To allow men of small capital to enter the trade, the purchase-money may be made payable in instalments on fixed dates and in this case removal of timber must be limited to the proportion paid for.

It is desirable that the officer holding the auction should have as exact an estimate as possible of the value of the lots he offers to enable him to distinguish genuine competition from a pre-arranged simulation of it. With lots containing one class of trees only, estimates are easy to make ; where the lots contain trees of all sizes it is more troublesome, especially so as estimates are generally kept 'confidential' until after the sale and the calculations have to be made by the estimating officer himself.

The system of estimating described below has been found useful for sales comprising about 60 lots containing about 28,000 trees of all sizes. Such a sale occupies about 3 hours inclusive of the time spent in taking earnest money.

Briefly the system is to get the value of all smaller trees in terms of the value of the mature or 1st class trees, and hence the equivalent of the whole lot in terms of mature or 1st class trees. Then assess the value of a 1st class tree and one multiplication gives the estimate. It is necessary to know the average outturn in cubic feet of trees of various girths for forest of each quality, and the average value per c.ft. of such outturn. The former is easily obtained from existing records, or if there are no records, from measurements taken for the purpose, the latter implies an acquaintance with the local market.

For example—Quality II.

Class of trees girth ...	3'—3'11"	4'—4'11"	5'—5'11"	6' and over.
Average c.ft. of outturn ...	17	25	36	70
Value per c.ft.	As. 6	As. 8	As. 11	Re. 1
Value per tree	Rs. 6-6	Rs. 12-8	Rs. 24-12	Rs. 70
Approximate No. of trees equal in value to one tree of 6' and over.	12	6	3	1

Note 1.—The proportions are approximately same for all qualities.

Note 2.—The value per c.ft. is that of the tree standing in the forest. It is obtained from the market rate by deducting cost of extraction and profit, *e.g.*, with a market rate at depot of Re. 1-8 per c.ft., extraction costs as. 4 per c.ft., and allowance for profit as. 4—the net value of the timber is Re. 1.

Note 3.—Allowance must be made for difficulty of extraction and for distance, *i.e.*, for increased cost of extraction and also for unsound trees. This is done by reducing the average value of a 1st class tree. As long as the proportions remain the same it is necessary only to assess a value for the average 1st class tree.

Example I.

Lot 26.

Class of tree... ...	3′—4′	4′—5′	5′—6′	6′ and over.	
No. of trees	388	282	185	61	
Equv. No. of 1st class trees ..	32	47	62	61	Total 202

Valuation 202 × 40 = Rs. 8,080.

In the example given above Rs. 40 is taken as the value of a 1st class tree although the quality is II because the lot contained dry trees only, hence a deduction is made for bored and unsound trees and for the inferior quality of the timber.

Example II.

Lot 16. Mostly green trees.

	3′—4′	4′—5′	5′—6′	6′ and over.	
	31	23	14	112	
Equv. in 1st class trees ...	2	4	5	112	Total 123.

Value 123 × 50 = Rs. 6,150.

Rupees 50 is taken as the value of a 1st class tree after allowing for unsound trees and distance from sale depôt.

This method of valuation may look complicated, but is very simple to use, the valuation of the sixty odd lots referred to above took less than 2 hours.

A. K. GLASSON, I.F.S.,

REVIEWS AND EXTRACTS.

FOREST RESOURCES OF THE WORLD.

BY

RAPHAEL ZON AND WILLIAM N. SPARHAWK, FOREST ECONOMISTS, FOREST SERVICE, U. S. DEPARTMENT OF AGRICULTURE—WITH AN INTRODUCTION, BY GIFFORD PINCHOT.

McGraw-Hill Publishing Co., Ltd., 6 and 8, Bouveric Street, London, E.C. 4, Price £ 2—2*s*.

The work is presented in two volumes covering 997 pages and including 431 tabular statements.

The following extract from the foreword by Gifford Pinchot may be quoted partly because of the eminence of the author and partly because of the very appreciative summary of the work contained in it.

"The Forest Resources of the World brings together in a critical way the available information and provides a solid foundation upon which to build through future national co-operation an organisation for the continuous collection of complete forest statistics. * * * * Hitherto most of the discussions of the forest resources of the world have been confined principally to the better known forests of temperate regions.

The vast undeveloped tropical forests were practically ignored. Now for the first time in my judgment, these forests are considered in their proper perspective in the general forest situation. As a guide to the forest resources of the nations and the world, as an analysis of the factors affecting the development of forest policies, and as a record of the progress of forest conservation in different countries, this book will have unique value to economists, administrators, foresters, exporters, importers, and users of forest products."

I am glad of an opportunity of reviewing the work because I had the pleasure of making Mr. Zon's acquaintance at Washington in 1918. The authors are to be congratulated on the excellent way in which they have performed their very ambitious task. The book does indeed deserve generous praise. It is a mine of information which is presented in a very readable form. The sympathetic and comprehensive way in which facts have been marshalled and inferences drawn displays a very broad outlook.

The reviewing of such a monumental work is something of an impossible task. From amongst the mass of statistical and general information about all parts of the world one can only pick out remarks here and there which attract attention either by their significance or by the personal associations connected with them. As a member of the I. F. S., I naturally look first of all to see what is said about India and Burma, and with regard to other countries the thought is constantly recurring as to how they stand as possible consumers of our timbers or as competitors with the same in the markets of the world.

The use of the cubic foot as the unit of measurement will appeal to English readers. It is rather a pity that areas are, for the most part, given in acres. It would have made the figures smaller if areas had been expressed in square miles. One cannot help making a good-humoured reference to the partiality of Americans for big figures. Millions and billions of cubic feet acres and dollars are common throughout the book and some times make your head swim. A million is hard enough to think about. I cannot attempt to try and visualise a billion of anything.

It would be unfair to criticise too closely the correctness of many of the figures given in the book. As the authors themselves say, many of their figures are very speculative, as satisfactory data are only available in the case of a few countries. This may be perfectly true and yet it serves a useful purpose to give estimates in figures because the significance of facts and inferences from them is much more easily appreciated when they are presented in such a concrete form.

There are nine chapters in the book. The first chapter (70 pages) under the heading of "The general Forest situation in the World" summarises the other eight chapters which deal with individual countries. I will content myself with a few remarks about chapter I and the part of chapter III dealing with India and Burma. In reviewing the forest resources of the world in general, the subject is presented from almost every conceivable point of view. Very complete tables are given showing for each country the forest area, the ratio of forest to the total land area and the forest area per 100 inhabitants. Then follows classification of the forests into Conifers, Temperate Hardwoods and Tropical Hardwoods. Next come data with regard to public and private ownership of forests with a short summary of Forest regulations in force. Several pages are then devoted to a discussion of the world's production and consumption of wood. The latter naturally leads to a consideration of the world's trade in timber. The chapter closes with an all too short paragraph under the title of "A look into the future". All the above aspects of the subject except the last one, I must leave the reader to study for himself in the book. Any one of the headings might well be taken as the text for a lengthy article in the future.

The authors come to the conclusion that there is room for serious reflection with regard to the world's future supplies of timber. It is pointed out that this conclusion may come as a surprise to many people because there is no very marked dimunition at present in the supplies of timber which reach the chief markets of the world With the development of cheap transportation, especially by sea, supplies have actually increased

along with the demand. One country can draw upon another from all parts of the world ; it need no longer depend on its own forests for its supplies of timber. All this is quite true, but it leaves untouched the fact that the area under forest throughout the world is bound to go on steadily diminishing owing to the increasing demand for land for agriculture and to the destruction of forests by fire or by cutting without provision for renewal. According to the authors, the production of wood throughout the world is considerably less than consumption. Their estimates of 38 billion c.ft. and 56 billion c ft. respectively may not be very reliable, but they are useful figures to bear in mind.

Three-quarters of the world's consumption of wood other than fuel comes from coniferous forests, and with regard to them the outlook is said to be none too bright. As the authors put it "whether they will be able to meet the demand depends upon what steps are taken during the next few years to put them on a permanent productive basis, as the forest capital in coniferous timber is being steadily depleted ; but even so there are hopeful factors in the situation because the potential growth of the existing coniferous forests under proper management is estimated at three times the present cut. Given, therefore, a proper desire for their maintenance on the part of the owners, there is no reason why the area should not remain as large as it is at present and why the production of timber on it should not increase beyond consumption."

The hope of the future is said to lie in the tropical hardwood forests. Not only do they contain the chief supplies of furniture and cabinet woods, but they could also yield enormous quantities of timber for industrial purpose, *e.g.*, railway sleepers, etc., under proper management. Very few people have any idea of the enormous extent of these forests, chiefly in Central and South America, Western Asia and Central Africa. Possibilities are indeed great, but there is much to be done before these possibilities can be realised. Hitherto supplies of mahogany and many other hardwoods have been obtained by depleting forests close to good floating streams. These easily accessible supplies are becoming exhausted and the time is now coming nearer and

nearer when it will only be possible to meet the demand by going in for much more elaborate and expensive methods of extraction. Railways and mechanical appliances must replace animal traction and hand labour. All this development will take time. The conclusion the authors come to is therefore that, for the next two or three generations at least, dependence must be placed chiefly on the coniferous forests of the northern hemisphere With regard to the expansion of trade in tropical hardwoods the following remark is significant :—

" When development of the tropical forest industry does take place it will be accompanied by other phases of development which will have an important bearing on the general problem. In the first place, the tendency in all new countries is to try and hasten development by all sorts of inducements to private exploiters such as concessions of public lands and forests and a large measure of freedom from restrictions as to their use of the resources. A very large part of the tropical forests may be expected to pass into private ownership and to be exploited just as wastefully as forests of all other regions under similar circumstances. Meanwhile the forests will continue to be reduced in area and the quality of those remaining will tend to deteriorate until the timber resources become so badly depleted that steps are taken to prevent further deterioration. The history of forestry in most countries shows that effective steps towards forest regulation are seldom taken until a country's forests resource had become so depleted as to make it anxious regarding its own future supplies. It is very doubtful whether the equatorial forests can be counted on to supply a large part of the timber needed by the northern countries."

Chapter III contains 16 pages about India and Burma Annual growth, at 15 c.ft. per acre, is estimated at 1½ billion c.ft. The annual cut is put at 347 million c.ft. and loss from waste, decay and fire, 35½ millions. But in spite of the fact that the annual growth is nearly 3½ times the cut, India is a wood importing country. Annual imports exceed exports by 2¾ million c.ft. No one is likely to question the remark that India is still un-

developed and industrially backward, and that the existing forest resources have hardly been touched. But the authors go on to say that although India will be able to supply large quantities of timber to the rest of the world and in this way may even balance its timber trade, "it will be dependent upon importation for the more common coniferous woods." I venture to question the correctness of the last inference and it would be interesting to have the views of Foresters in the Punjab and United Provinces. The area of conifers in the Himalayas is estimated at 2½ million acres. It is hard to believe that exploitation of these forests cannot be developed by up-to-date methods to such an extent that the importation of softwoods would not be appreciably reduced. Morever, the authors do not, I think, take into account sufficiently the fact that imports into India from Burma and the Andamans for ordinary industrial purposes including railway sleepers are bound to increase. The supplies of timber suitable for sleepers in Burma are so large that they ought to go a long way towards meeting India's requirements on better terms than from either British Columbia or Australia. The problem before Foresters in India and Burma is obviously to develop extraction by improved methods.

Appreciative references are made to the progress made with forest conservation, education and research work. The remarks about the probable future in India and Burma are very suggestive. It is interesting to note that the authors come to the same conclusion as ourselves with regard to development of export trade in timber. Freight charges from India to the United Kingdom are said to be more than double those from Canada, nearly double those from British Columbia, somewhat more than those from South America, but considerably less than those from Western Australia. The inference is therefore drawn that India and Burma can compete successfully with other countries with regard to shipment of high class timbers but they cannot hope to do so with regard to coniferous and other timbers of the cheaper grades. The choice of timbers for export is therefore narrowed down to those suitable for high class decorative and structural work,

furniture and various other industries demanding woods of special qualities. Owing to their distance from the sea coast, the forests in the Himalayas are ruled out. Burma, the Andamans and the West Coast of India proper give most promise for the development of exports. The huge extent of possible supplies from Burma is recognised. It is also noted what we, although reluctantly, must admit to be true, namely, that up to the present the efforts of Government to induce timber firms to develop the export trade in timber other than teak have not received much encouragement.

The last chapter in the book is devoted to "Forest resources other than timber";—Pulp, resins, and gums including turpentine and rosin (known in the U. S. A. as Naval Stores), rubber, tannin materials, dyes, cork, wood distillation and edible products are mentioned, but there is one rather striking omission. I am surprised to find no mention of lac anywhere in the book. The omission is all the more striking because India holds a practical monopoly for the whole world. Trade is already very large and it is bound to develop. In statement XV of the statistics relating to Forest Administration in British India for the year 1921-22, exports of lac are given as 21,747 tons, the value of which at port of shipment is put at the huge figure of 791 lakhs of rupees or $5\frac{1}{4}$ million sterling. It may come as a surprise to other Forest Officers besides myself to learn that lac is far and away the most valuable product of our forests. Our most valuable timber, teak takes second place. In the same tabular statement the value of teak exported from India is put at 46 lakhs of rupees. Even if the value of teak timber exported from Burma in the same year be added, namely, 225 lakhs, the total comes to 271 lakhs, or only about one-third of the value of lac exports. We may well therefore take more interest than many of us do at present in Burma in the cultivation of lac. In the Central Provinces it is now being done on an extensive scale and Provincial revenues are already feeling the benefit of the enterprise.

F. A. L.

SOWERS AND REAPERS.

A TALE OF THE FORESTS.

II.—THE REAPERS.

Thirty years had gone. To-day it was bazaar in Randungar. Instead of the old village green there was a wide-walled enclosure with lofty arched portal and figured bastions at all corners, stone-benches and fountain and shady trees. To such grandeur had the prosperity of Randungar led the inhabitants. But to-day only a score or so of people were to be seen and the wares to be bartered needed no bullocks to bring them. Headloads sufficed. An air of listlessness and depression pervaded the place. Dull was the market and dull the people. Yet it was the same people or their children, to whom Pesterchand Vakil had restored the forests a generation ago. How was this?

A knot of half a dozen cultivators sat with their backs inside the square shallow *kund* of the fountain and were deep in conversation. Most were young men but one was old and gaunt and a long beard gave him a venerable appearance which fitted well with the measured wisdom of his speech. For wise he was. This was Bhiku Koyaji Shahana and he was son of Koyaji, the Shikari and was surnamed Shahana because he knew. And what he knew he was telling. And up to this group there strolled a headmn of Vanjaris who had just left his womenfolk and children watering a thirsty pack of bullocks, for they had come from a far-off district. The Vanjari sat him down and listened and then began to ask question. "How is this?" he said, "I had learned the people of this taluka were given back the forests as of old time and had prospered exceedingly. I came here to barter. But there is not the grain in this *wada* for that I would give one bullock-load of dried fish. Tell me. Mahatara. Surely the sale of timber alone must make you rich."

"Yes,' said old Bhiku, "and so it did—for a time. After they gave the forests to us the revenue officers let us cut the timber to sell in the market. We only had to pay a nominal fee for a cartload and took it away on permits. We grew rich on the proceeds and when the time came for refixing the land assessment

the Government people said, 'Now there is no revenue from the forest *khata* you must pay higher assessment on your land,' and we could, so we said nothing and paid. All would have continued well had we been of one mind and cut fairly from the old trees and left the young hopeful poles to replace them. But where then was our thrift? Besides, Jiwanji Makanji Swakar at the start had fifty carts and pairs of bullocks to anyone's five and so he began to take ten times his share, whereupon Dagadu Mahar, not to be outdone, sold all his land and chattels and got him more carts and pairs than Jiwanji, and he was a good axeman to boot so that he cut next year more trees than Jiwanji. Thus it began and thus went on, till they cut more timber than they could lift and it rotted in the forest. Not only that: had they cut the trees low by the stump as those forests fellows used to insist on (and how we laughed at them!) at least our children would have seen the new shoots grow up into poles, and our grand-children the poles into trees. No, we cut breast high to save labour and we cut old and young alike till there was no timber to call a rafter left. Thus we are, and the high assessment we must pay till next revision. Now it would take an age to restore the forests to timber and the forest-wallas alone could do it. In the end we have lost and are poorer."

"But what about the grazing?" asked the Vanjari, "Surely it is better to pay no fee and graze your cattle where you like and more wealth to you? Tell me this, Mahatara," and he leaned on his staff and puffed his *bidi*. "It was thus" the old man went on. "The fees we did not like I grant, and the cattle pounds still less, and there were fees and fees to collect, till the forest saheb transferred the ranger Potbharkar because after two months he returned his new pantalons saying they are only forty-two inches girth round the *kamarpatti* But even in the grazing we have not scored. At least the fee per head made us a little more careful to keep better cattle, for why pay on rubbish, and the breed was improving slowly. When fees stopped, the poorer animals remained with us and the stock got worse again. But that was not the flaw in the gourd You must know there are the dry hill forests

here above the Ghats and the cold forests below as round Palaskhond And what happened in the *dungarpatti* but we must go and burn the forests year after year, so not only we got no grazing in the hot season but in the four months the rains washed down the soil where we had cleared the trees away and now there is little to keep a goat browsing. Down in the rich teak pole belt round Palaskhond the forest-wallas in the old days kept the ground more or less open because they let the teak trees grow and spread and cut the creepers. But when we were allowed to cut out the trees and do no sowings or plantings, what happened but the jungles grew full of soft woods and tangled with thorns and creepers so the cattle could hardly go in to graze and when they did they strayed or the tigers ate them? Truly our cattle are lost and we are lost."

The Vanjari heard and wondered. Such was not the talk he had thought to hear in Randungar. Surely this old man was making the worst of things or wanted the Mamlatdar's peon to overhear him as the prelude to beseeching some favour? So he turned to one of the others, a lean yellow-eyed Kunbi, whose only rotundity lay in the region of his spleen and he rallied him saying, "Na Laxman, how is it? One used to say the forest guards were an oppression and you could not cut an axle or a yoke under ten rupees fine or a month's hard labour. Whence your ugly yellow eyes and drawn skin and your belly where it should not be? The wise men were saying forest protection brings fever and wild beasts and drives away cultivators. For thirty years you are free men and see, your numbers are small and your spleens large. Will nothing please you?"

The Kunbi liked the cheery stranger and the ghost of his old smile lit up his face. Long he pondered and when he spoke his words came not flowing but like the rice grains in a seed drill, a few at a time and halting. But he spoke the pent up thoughts, of many years and they who listened were patient for they felt with him. "Touching your first word, we had our time with the axles and poles, indeed with the *rab* as well and the use of fruit trees and everything else. But give me the old beatguard and

forester back. We did not quite love them and would abuse them at times. Why, the guards of Betgaon Forests had B. F. on their caps till the conservator saheb said they were well named and changed it to R. F. which means *gairan*. But they knew their job and they would not have let us hack over first the *dhaura* and the *dhamni*, and when they were gone (for we wasted and took only perfect pieces) then the less good *asana* and *warang* till in the end anything we could find that was straight, now even that is gone and the trees that made for useful things are fit only for firewood and crooked at that. And the *rab* trees died as indeed they were bound to die, for did not the forester tell us the leaves are a tree's mouth, and who can live with his mouth gone? We had to go so far for our *rab* at the last, it is now hardly worth while to grow rice and *nagly*. And the fruit trees! We filled the bazaar every week, but after a while there was not a live mango or hog plum, or *bhor*, or *mowhra* tree within miles of our village, for the nearest man would girdle his trees to get more fruit than his neighbour. So now when a lean year comes we fast indeed. The fever was there before Pesterchand got us the forest rights but now it is worse. Some people are fools. They thought that, call the forest anything but *gairan* and it will recede and oppress the people no more. Again, the talking people would tell Government "the pig and sambhar and fearsome animals will leave if you take away the forest staff and make the forest free." But how different it all turned out! At first we were so rich we knew not where we were. Then we remembered what Koyaji Shikari had told us. After all, we used in the old days to get the help of the guards to shikar the pig. They were quite decent about this. It was good fun and we liked the flesh. Give the guard a sambhar's ribs and inside bits, and he is like one of ourselves. Now there is none to help us. The foresters had been at the school in Shelonde and they knew how to keep the forest free of useless stuff and grow straight trees. Now the clearings we made round the villages are thickets, encroaching even on the rice-fields. Above ghats the water-holes are dried up and we drink bad water and get fever. The forests on the hills are gone leaving a bare desert. Shifting cultivation alone

would have destoryed them. Down in Palaskhond the bad jungle is everywhere and the people have died of fever or given up their lands. Even a beat guard was wise and we laughed at him. Now we are wise and it is too late."

Then old Bhiku Shahana took up the tale again. "Yes, and we are losers in yet another way. There were all the forest works, on which we earned good wages when field work was slack so that we could buy even *Sarkari* liquor and look the excise inspector in the face when the *mowhra* flowers were ripe." Then he paused, and spoke again with emphasis and conviction. "The forest privileges were liberal, though we would say otherwise. Perhaps they might even have been increased by peaceful agitation. The forest rules were not really made to harass us though we may have thought so. They were made to preserve the forests, that our children and grand-childern might still live among them and take of Nature's bounty. And to produce revenue for the *Sarkar* so that the taxes sit lightly on us."

And so it went on. One cultivator after another testified to the havoc the untended and ruined forests had wrought and the drying up of the stream of wealth that once had flowed from them. Then an old *waddar* or stone-breaker got up and swore a curious oath concerning the insides of the donkeys he plied his trade with. "We have suffered long" he said, and all gave him ear. "And it has been our own fault. We listened to Pesterchand when we ought to have heeded the word of Koyaji, the Shikari. But why should we suffer for ever? The forests can be restored in time and with care. Now we have our own Member who is also a Kunbi. Let us seek him and make him speak for us." And they did.

"I put it to this Assembly that the policy of abandoning the forests has been a big mistake. You had a store of wealth but it is squandered to gain favour with the people. Even that we have not retained. We have lost a steady and increasing revenue and done the people harm. The villages are deserted the country-side is impoverished and fever ridden. The forests are

the people's but they no longer want them. For they have ruined them and now the jungle has mastered them in turn. It is for you to restore the forests for Government and for the people."

And so it came that the forest staff was reinstated and the wild jungle was gradually reclaimed and became again a source of revenue to Government and of prosperity to the ryot. Peace and plenty reigned once more in Randungar.

Now all this story is much too good to be true. And it is not true. For Bhiku, son of Koyaji Shikari had fallen asleep on the hill thirty years ago and dreamed it all. His father had talked much with him about the unreasonable dislike of the forest rules and policy and his words had gone home. So Bhiku dreamed and when he woke he was wise and that is why he is called Bhiku Koyaji Shahana to this day.—[*The Times of India*].

FOREST FIRES.

BY L. E. W. BERKELEY.

All who have concern with forests and forestry must with real regret have read of the wholesale destruction by fire of the forests of the Riviera. Thousands of acres of the forests, of Esterel, the Maures, and the Landes have been destroyed. Over a front of 40 miles on the Côte d'Azur, châteaux, villas cottages, and even whole villages have been consumed, and people have had to flee for their lives from this most terrifying of all disasters. The loss to forests alone has been estimated at over £300,000. It is perhaps only in the face of a catastrophe of this kind that the necessity for being well prepared is realised. France has suffered much from such losses to her forests, and has given much thought to their prevention, but even so, in spite of her sufferings and the loud clamour of the sufferers, so cumbrous and ponderous a thing is the law of a land that she is even yet without effective legislation on the matter. As a witty Frenchman recently remarked, "Unfortunately in the race between Fire and the Law, Fire is always an easy first."

But there is always talk of more effective legislation. The people most concerned, dwellers in forest lands, the mayors of communes, and private owners, foregather and discuss the matter constantly. In May of this year a commission met at Morceux to consider the matter. There were present all the mayors of the more important towns and villages of the Landes. It seems that recent additions to the law are very unpopular in the Landes, if one may judge by some of the criticisms. Great exception was taken to the powers given to the authorities to create counter-fires, it being considered a grave blow to the rights of the proprietor and quite inadmissible. Some proprietor threatened that should such a thing take place on their land they would take legal proceedings. Others said a counter-fire had never been known to extinguish a forest fire. And others yet again very pointedly remarked that the forest officers who created these laws were often quite ignorant of the type of forest in the Landesh, having gained their experience in totally different places. A member of the Senate, M. Cadilhon, said that this authorisation to light counter-fires was a serious blow not only to the proprietors, but also to the mayors, in their long-recognised position as the authority in organising all counter-attacks. He submitted that the laws of 1864 and 1902 were quite sufficient if one added thereto the obligation tc creat associations of defence, and if insistence were laid on the necessity of the very thorough cleaning of plantations (*i.e.*, the removal of gorse and heather), the increase of forest roads and the creation of signs of warning. He added that he thought there was very real reason to amend the law, and promised to bring the matter to the notice of the Senate.

In the meantime, the energetic Minister of Agriculture has done his best by addressing a long circular to his prefects to remind them of the powers they already possess in this direction. He cited principally Article 10 of the law of June 21st, 1898, on rural police, which permits prefects to prescribe the precautions necessary to avoid danger from fires, and particularly to forbid the lighting of fires in fields within a given distance of woods.

Reference might also have been made to Articles 3 and 4 of Chapter VI of the French law of August 1790, on the preser-

vation of property and public security; and Articles 91, 97 and 99 of the Municipal law of 1884, which confers useful powers equally on prefects and mayors. In the department of Pyu-de-Dôme an Order of July 1922, prescribed special measures relating to the mowing of grass within a distance of 500 yards of plantations, and mayors are given special authority with regard to the precaution necessary to protect woods. But there are many departments where the ministerial circular might receive closer attention, and this even in regions where each year there are veritable disasters caused by negligence or by the carelessness of tourists.

Attention has also been turned to mechanical devices for suppressing fires, and very thorough tests were made recently at Bordeaux of a new extinguishing apparatus called the "Knock-out." The extinguishing factor is compressed carbonic acid contained in a liquid, and ejected in the form of a spray ten times the volume of the containing liquid. The apparatus tried was of two types, one portable with a capacity of 10 litres, producing 100 litres of spray, and one on wheels with 100-litre capacity producing 1,000 litres of the extinguishing element.

The experiments took place on the Place des Quinconces, an enormous open space in the centre of the town on the banks of the Garonne, and in the presence of many forest conservators, members of the agricultural service, and commandants of the local fire corps. Large masses of firewood were prepared soaked in turpentine, and the experiments began with the smallest pile. After it was thoroughly well alight, the hand apparatus was brought into play, and the fire was extinguished in a few seconds. Larger fires followed and were rapidly put out by the large machines. In no case was it found possible to relight the fires. Some of the spray was then allowed to fall upon the earth, and over it turpentine was poured; attempts were then made to set fire to the turpentine, but it was found impossible to do so.

After these successful experiments it was decided to try the apparatus in the forest if a suitable place could be found. State forests were not considered suitable, because they are

kept well cleaned, and the presence of considerable quantities of broom and gorse to accelerate the fire was essential to a genuine test. The General Commanding the 18th Army Corps came forward with the offer of a piece of ground belonging to the camp at Souge; it was well covered with gorse and heather and young pines, and would have had to be cleaned eventually for the uses of the camp, and here, on a warm July day, with a moderate wind blowing, the experiments took place. Officers from the camp and conservators and inspectors of forests were present. The inventor, M. Bouillon, brought many examples of the apparatus with him, including several of the 10-litre hand type, one to be carried on the back of a 20-litre capacity, two of the 100-litre type on wheels, and one very large pump containing 400 litres. All, except the 10-litre type, were fitted with taps so that they could be worked or stopped at will.

The preliminary preparations included digging a cleared trench, free from gorse, round the experimental plot, and placing Senegalese soldiers armed with branches at intervals along it to watch for sparks. The soil was very sandy, and the plot was situated at about 300 metres from a metalled road.

The first fire, lighted by a conservator at 9-35 a.m., developed very slowly, but when it was burning thoroughly was extinguished in three minutes with two 10-litre apparatuses. A second fire was lighted at 9·55. When it had completed a semi-circle of the plot, the conservator gave the signal and an apparatus of 100 litres was wheeled into action. The spray carried a distance of about 80 metres, and in one minute, with the expenditure of only 50 litres, the fire was out. The tap arrangement had saved the remaining half of the liquid.

A third experiment was made that consisted of throwing a barrage of the spray into the midst of a mass of high gorse, whilst a fire was lighted twenty yards away on the windward side. The fire caught, and blazed, but was completely stopped when it reached the spray-soaked gorse. The effect was complete, and was brought about by one 10-litre apparatus and a few branches. A fourth fire was then lighted and overcome with the same success.

These experiments proved that, without a doubt, the "Knock-out" is a very complete and efficient apparatus for combating forest fires in early stages, and that in cases where the fire has gained ground it can be of service along the flanks and at the point, and will considerably diminish its progress. It would be useful also in maintaining counter-fires, which have often to be lighted after the extinction of the main fire, in order to burn up the smouldering débris that would otherwise continue to be a source of danger. It may be argued that much the same results may be obtained with water, but it must be remembered that the apparatus produces an extinguishing spray ten times the volume of the liquid it contains, and that its effects are of much longer duration than those of water. Certainly, the 10-litre types are small for forest use, and the 10-litre, with a weight of 30 kilos, is heavy for hand work. The 100-litre on wheels is much the most practical from the forester's point of view, for the 400-litre pump might prove difficult to transport. Where water is at hand the apparatus can be recharged and so held always ready for use. It is not to be supposed that the apparatus does away with the necessity for the use of branches or any other possible means of combating the flames, but it does prove a very efficient aid to other means, and it will doubtless be improved upon as time and experience show its weaker points.

There is still the realisation, though, that, in the prevention of forest fires, much remains to be done, and that the whole system of forest protection should be constantly reviewed. Now ideas can do no harm, and there is always a possibility of their being useful. Forest officers new to a district, although not trained to that particular type of country, may for that very reason see at a glance dangers that have been passed over for years by more experienced eyes. One wonders, tentatively, whether it may not be found necessary to reconstruct the whole system of railways in the Landes. There, in that country of resinous pines, with its long, hot summers and dry sandy soil covered with gorse and broom, the narrow width of the railway cuttings is a thing to marvel at. It is true that there are spark-catchers on all locomotives, but he would be a bold man who sug-

gested that no spark could possibly escape from them. Tentatively also, one might suggest that a clearing of a prescribed width around all villages would serve in no small measure to protect both village and forest.

But England does not presume to, or France. We in England, totally devoid as we have been of any systematic forest method, are compelled to look with envious admiration at France's four hundred years or so of far-seeing, clear-sighted management, and when disaster so overwhelming as the recent fires overtakes her, our sympathy is mingled with no little astonishment; but that will not hinder us from offering our condolences and according her the homage that is so much her due for her superb achievements.—[*Quarterly Journal of Forestry, Vol. XVII, No. 4, October 1923.*]

A POLE RAILWAY FOR THE REMOVAL OF TIMBER FROM STEEP AND DIFFICULT HILLSIDES.

BY G. J. CAMERON.

During the years 1916—18 a large quantity of pit-props was cut, peeled and stacked in the north of Scotland on a hillside practically inaccessible to horses and carts. The use of steel rails at that period was out of the question, as they could not be got at any price. It was decided to lay a pole railway from the centre of the area containing the props to the public road, a distance of about two miles.

The method of laying the track was as follows :—The line of the track was indicated by a series of poles, which were put int the ground at certain points over these two miles to guide the workmen. Curves were made with as wide a radius as possible. A squad of six men was employed for the actual construction, divided into three groups of two. The first two went on ahead with spades and levelled the ground for about 2½ feet on either side of the marking poles. Tree roots and stones likely to give trouble were removed. Immediately behind the first two workmen the second pair followed, and were provided with spades and axes. They laid the cross-pieces or ties, which were made from

good, straight props, cut six feet long and about five inches in diameter. These were bedded in the prepared track, and their upper surfaces roughly flattened with the axes. The cross-pieces were laid down at about three feet apart from centre to centre, and additional pieces were added if the ground was inclined to be wet or marshy.

The third pair of workmen fixed the poles which served as rails to the cross-pieces. They were provided with nail hammers, cross-cut saw and adze. The poles, both for cross-pieces and rails, were dragged by a horse to convenient points along the marked-out track. The rail poles were specially selected from the props already cut, and were laid on the cross-pieces and firmly nailed down. With the cross-cut saw the end of each pole was cut flush with the last cross-piece to which it was nailed, and six inches further back another saw-cut was made half through the pole, and the piece removed with the adze. Another pole was now selected, with a similar end diameter, and was cut to match the end of the pole already laid, before it was fitted in and nailed to the cross-pieces. The adjacent poles were thus made to fit tightly, and joined exactly above a cross-piece. If this is not done the joint is apt to sag when a heavy load passes over it. These joints take the place of the fish-plates used with ordinary steel rails, and it is therefore important that they should be carefully made and firmly nailed down.

When the two miles of track had been laid, a small traction engine and a brake drum were purchased, and fixed at the top of the steepest part of the track, about $1\frac{1}{2}$ miles from the public road. The engine was attached to the drum by a belt and a slack pulley. Eight waggons or bogies were in use. Horses hauled one waggon apiece over the half mile of track from the point where the props were collected to the engine. On their arrival there the horses were unyoked, and the end of the steel cable was attached to one of the bogies by a steel hook. Four of them were then coupled together, and with a slight push they were put in motion downhill, the men at the brake handle regulating their speed. When the bogies arrived at the bottom, the props were quickly transferred to

road waggons, and hauled by a traction engine to the railway station. A signal by hand was given to the man in charge of the brake drum, who put the engine in motion and hauled the empty bogies to the top of the hill. The drum coiled up the steel cable without any trouble, as this part of the track had no sharp curves. By this means every prop was taken off the hill and a handsome profit was realised on them. Without the pole railway they might still have been standing, as even at the time they were cut they had been permanently injured by squirrels, and that, combined with the difficulty of getting them to the railway station, made it look as if they could not be sold except at a loss. The pole railway solved the transport problem cheaply and effectively and the cost of upkeep was practically nil.—[*Transactions of the Royal Scottish Arboricultural Society, Vol. XXXVII, Part I, July* 1923.]

A NOTE ON THE CONCESSIONS GRANTED BY THE MADRAS GOVERNMENT TO EX-SERVICE MEN.

PREPARED BY M.R.RY. RAO BAHADUR M. C. RAJA AVL., M.L.C.

The concessions offered by the Government to men who joined the army in the late war may be classified under three heads. First, facilities were granted to them for acquiring and owning land at the disposal of the Government. This besides being an inducement to men to enlist, was intended to help them to settle down with some means when the war was over. Again, the Government directed that certain educational facilities should be afforded to the childern of soldiers. Thirdly, both as a stimulus to recruitment and as a method of improving the prospects of soldiers on their return, they issued certain instructions regarding their admission into the Civil Departments of the Government on posts carrying a salary befitting their status, or otherwise finding employment for them on their return.

The following is a summary of the concession thus promulgated in this three-fold direction :—

Taking first the subject of grant of lands.

Assignment of lands.

Early in 1916 and when the Great War was in progress the Government of Madras ordered that the Collectors of districts should give preference in disposing of *darkhasts* to applicants who were themselves recruits or who were related as father, mother or brother to recruits actually accepted for service with the colours. This was independent of a scheme which had already been sanctioned of making grants to Indian soldiers who distinguished themselves in the war, or to their heirs. For the assignment of land to these distinguished soldiers certain areas of land had been already ear-marked.

The order of 1916 allowed the assignment of land to a recruit only in the village from which he came. It gave retrospective effect to this concession to all recruits who had enlisted since the beginning of the war. Towards the close of that year the question was raised whether the condition that these recruits should be given lands only in their own villages would not involve hardship since some recruits were drawn from *zamindari* villages, and in some villages no Government land was available; and the Government then relaxed the rule and ordered that if a recruit "belongs to a zamindari or whole inam village or if there is no land available in his village, lands in an adjoining village may at the Collector's discretion be assigned to him". The Government at the same time in January 1917 agreed to these concessions being applied to all Indian soldiers on active service, whether recruited since the outbreak of the war or before it. In G.O. No. 3646, Revenue, dated 17th November 1917, the then existing concession were summarised and set forth clearly with only two noteworthy changes—one was that the father, mother or brother to a recruit, who had the privilege of applying for lands on behalf of the recruit, was not recognised under the later order; and the second was that in all cases of assignment of land to soldiers under these rules, Collectors were authorised to waive the collection of the value of trees existing on the land up to a maximum value at first of Rs. 50 and later of

Rs. 500, the limit already prescribed in the case of distinguished soldiers. In the case of the latter the recovery of demarcation charges was also waived altogether. The concessions regarding the grant of land on *darkhast* to recruits and men on active service were also extended to discharged combatant soldiers, provided application for such land was made within 12 months from the date of discharge. Even waste lands commanded by the Divi pumping project were ordered to be assigned to sepoys and all grants of land were ordered to be subject to the condition that the lands should be brought under cultivation within a specified period.

In August 1920, *i.e.*, a little less than two years after, the conclusion of the armistice, these concessions in regard to the assignment of land were withdrawn with effect from that date, and a general rule was laid down that military service should always be taken into account in deciding rival claims to grants of land under the darkhast rules. This was done with the approval of the General Officer Commanding, 9th Secunderabad Division. This position was made clear in G. O. No. 870, Revenue, dated 14th April, 1921, which holds good to-day and will be in force till April 1924. According to this order officers and men who served in the late war, whether as combatants or non-combatants, should be accorded preferential treatment in *darkhast* cases subject to certain conditions such as that the preferential claim should be limited to a single grant and the grant should not ordinarily exceed 5 acres of wet land or 10 acres of dry.

We take now the educational facilities that were granted.

In March 1918 the Government ordered that the children of men who enlisted in the combatant branches of the Army during the war should, so long as their fathers remained in the service, be exempt from the payment of fees in elementary schools and allowed to pay half the standard rates of fees in colleges and secondary schools. The Government of India soon afterwards issued special instructions involving similar and enlarged concessions in the case of children of deceased or incapacitated Indian soldiers and officers, and in pursuance there

of the local Government waived the collection of school fees both in elementary and secondary schools and sanctioned the grant of an allowance to the pupils for the purchase of books, etc. The original order of March 1918 was subsequently amplified so as to include the children of sepoys who enlisted as combatants prior to the outbreak of war. In July 1919 the concession was extended so as to include children of soldiers discharged on other than medical grounds, but not for misconduct or inefficiency. In their case the concession extended only to the payment of half the standard rates of fees in elementary schools and in addition an allowance for the purchase of books, slates, etc. In October 1919 the concession was again extended to brothers and sisters of deceased or incapacitated soldiers, if they were solely dependent on such soldiers and were left without other means of support.

In a later order it was directed that in determining the fee concession applicable to children of Muhammadan soldiers and of soldiers belonging to backward communities studying in secondary schools and colleges, who were already entitled to half fee concession under the Educational Rules, the standard rates of fees should be reckoned at half the rates applicable to ordinary pupils. In other words, they were required to pay only a quarter of the standard rates of fees.

In September 1921 the original order was re-stated so as to apply to the children of all Indian soldiers, whether combatant or non-combatant, who were on the active list between the 4th August 1914 and 11th November 1919, and the childern of all ranks of Imperial Service Troops—provided in every case that the parents or guardians of such children were not in affluent circumstances. Children of soldiers who retired or were discharged prior to the outbreak of the war were of course not taken into account.

In November 1921 the concessions originally granted for children reading in elementary and secondary schools were extended to colleges.

Finally as a permanent order the Government laid down in September 1922 that these concessions might be granted at

their discretion by Collectors to brothers and sisters of Indian soldiers and of those belonging to Imperial Service Troops who were on the active list between the 4th August 1914 and the 11th November 1919, provided the children are solely dependent on such soldiers and left without other means of support. This order is still in force.

In February 1923 orders were issued authorising Collectors of districts to extend at their discretion the privilege of exemption from payment of fees in colleges to the class of people mentioned above.

Turning now to the measures taken to ensure employment to these ex-service men.

In April 1918, in order to avoid the application of the ordinary age bar for entry into Government service and to make it easier for ex-soldiers to obtain civil employment, the Government issued orders that Heads of Departments should exclude from a candidate's age any period during which he was serving in the combatant ranks of the army, that all appointments in Government service on pay not exceeding Rs. 15 per mensem should, from then onwards and for the period of the war only, be filled only temporarily, so that men returning from the war might have a chance of getting appointments, and that men who enrolled as combatants might register their applications for the branches of the Government service to which they would like to be appointed on return. In June 1919 the time limit regarding the reservation of permanent posts on pay not exceeding Rs. 15 per mensem for the period of the war was extended to a period of one year after the declaration of peace in order to cover the time of demobilisation, and it was also laid down as a permanent measure that in filling vacancies on Rs. 15 and below, perference should always be given to men who had served in the army, provided they were otherwise qualified by character and education. In a resolution of August 1919 the Government of India issued comprehensive instructions in the matter and extended the privilege of perference to all posts whether on Rs. 15 or above.

To make the position clearer the Government of Madras finally issued two orders explaining the lines of policy enunciated in the Government of India's resolution (G. O. No. 319, Public, dated 8th April, 1922, and G. O. No. 74, Public, dated 5th February 1923). In these orders the Government directed that all appointments in Government service on less than Rs. 35 in the *mufassal* and Rs. 40 in the city should be reserved for ex-sepoys, combatants or non-combatants, until, further orders, and that in filling up vacancies in clerical appointments Heads of Departments should give preference to ex-soldiers and to clerks who had been trained in the Overseas Training School and who had actually served during the war. These orders are in force to-day.

As the supply of posts is not inexhaustible and as the Government continue to receive a very large number of applications from men who joined the army generally in a clerical capacity long after active operations and the danger that they entailed had ceased, they have recently made it clear that special concessions in the matter of land grants and employment will be reserved only for those soldiers and military clerks who were actually recruited before the 11th November 1918—the date of the Armistice.

NOTE ON TAUNGYA PLANTATIONS IN THE CHITTAGONG HILL TRACTS DIVISION, BENGAL.

History.—In 1912, the Divisional Officer arranged for 6 houses of *jhumias* (shifting cultivators) and started a *taungya* plantation on the left bank of the Karnafuli river about a mile from Kaptai Station. Teak seeds were sown $6' \times 6'$ in lines with the paddy. Most of the seeds failed to germinate and seedlings from the nursery were transplanted to fill up the vacancies. The *jhumias* were paid at Rs. 10 per 1,000 healthy seedlings in April of the following year after counting. Extensive cleanings were carried out during the ensuing year.

In 1913, a further area of 10 acres was cleared by the *jhumias* and teak seeds sown as in 1912. In both these plantations no second year's cultivation was done. Some *jarul* (*Lagerstrœmia Flos-Reginæ*) and *chapalish* (*Artocarpus Chaplasha*) were sown with the teak.

Nothing more was done until 1917 when an area of 20 acres was planted up on the bank of Kaptai river. All the produce was cut and sold to purchasers and two years' cultivation was done. The ground is flat and there are some water-logged areas in the plot where growth of the teak was very slow and grass came up. Subsequently some drains have been cut and drained the area, now the entire area is filled up. There is a pure patch of mahogany in this area, the growth of which is excellent, but it was badly damaged by squirrels in 1921.

From 1918 regular *taungya* work was started in the Hill Tracts Division. First, two years' cultivation was tried, but the *jhumias* did not get sufficient crop in the second year, especially with *gamhari* (*Gmelina arborea*) and teak, so they were not willing to cultivate for two years in the *taungya*. They agreed, however, to keep the *taungya* clear for the second rains and were willing to do three clearings, one by the end of March, one in June and one in August. At first the reward was fully paid in April after counting the seedlings, as is done in Burma, but from 1920 the system was changed. Now, for 25 per cent. of the seedlings payment is made

in April, and the balance is paid in August so that we are sure about the rains clearing being done by the *jhumias.* In their eement a clause is also added that if they leave the *jhums* and do not do the clearings during the rains, they will pay Rs. 10 per thousand seedlings as compensation; because to do the clearing three times by daily labour costs more than this.

From 1920 the *taungya* system was extended all over the Division and is now done in three Ranges instead of one. The entire Hill Tracts is full of sand flies, so the plantation work during the rain is really very troublesome.

Species sown.—The following species are sown pure in the Taungya :—

(1) Teak ... ... From 1912.
(2) *Gamhar* ... ... " 1918.
(3) *Jarul* ... ... " 1918.
(4) *Mahogany* ... .. " 1917 in a small patch.

The following species are sown mixed :—

(1) *Toon* (*Cedrela Toona*).
(2) *Chikrasi* (*Chikrassia tabularis*).
(3) *Chapalish.*
(4) *Siris* (*Albizzia sp.*).

Jhumias.—The *jhumias* in the Sitapahar Range included both Chakmas and Maghs at the beginning, but the Chakmas, being very lazy people, left the area in 1920, and now all the *jhumias* are Maghs. The Maghs are a very useful class of *jhumias* and plenty of them are available in Sitapahar Range, but they are not willing to go where the Chakmas are powerful as in Kassalong.

Prescription in the new working plan.—The new working plan prescribes clear felling and regeneration by *taungya* method. The maximum area prescribed in Kassalong is 660 acres and in Sitapahar Range 172 acres. It will be easy to regenerate up to 172 acres in Sitapahar Range by *taungya*, but sufficient *jhumias* will not be available in Kassalong Range, which is in the Chakma Circle, to regenerate the maximum prescribed.

Description of the plantations.—1912 :—10 acre. This is really a pure teak *taungya* with only few *jarul* and *chapalish* here and there,

but there is a small plot of pure *jarul.* In 1918 a regular crown thinning was done in this area and again in 1922 a light crown thinning was down. The growth is very satisfactory, the average height growth being about 60′ and the average girth of 20 best trees is 2′ 11″ at an age of 11 years. The girth of the best tree is 3′ 2″.

1913:—10 acres. This is also a pure teak *taungya*, contains a few low places where water remains stagnant. The growth of the teak in those places was very poor and sungrass came in. A few drains were cut and the grass has been nearly killed out. A light crown thinning was done in 1922, but the Conservator after inspection advised a second thinning at once, so a second crown thinning was done in the rains of 1923. The age of the crop is 10 years and the best tree has a girth of 2′ 10″ and a height of about 50′.

1917:—20 acres. This is a pure teak *taungya* containing only a small patch of mahogany. It is entirely on flat land and contains a few water-logged areas where the growth of teak is poor and sungrass came up. After cutting regular drains the grass was killed out. The age of the *taungya* is 6 years and as it required thinning badly in some patches, a crown thinning was done in these areas during the rains of 1923. The growth of the teak is promising, the height growth is over 50′ and girth 12′ 3″. The mahogany area was badly damaged by squirrels in 1921, but most of the trees recovered.

1918:—80 acres. This *taungya* is a mixed one. The area is 80 acres and contains *gamhar*, teak, mahogany, *chapalish*, *siris* and *jarul.* Formerly only teak was tried as a pure crop, but in this year pure crops of *jarul* and *gamhar* were also tried. The area of pure *gamhar* is 3 acres and that of pure *jarul* the same. The growth of both is excellent. A sample plot in the *gamhar* area was started in 1920 and it is proposed to start one in *jarul* area. The height of the *gamhar* in 1923 is nearly 60′ and girth more than 3′. The height of *jarul* is 15′ and girth more than 12 inches.

1919:—78 acres. A *taungya* of 78 acres was tried this year on the same lines as in 1918. Several plots of pure *gamhari* were

1. 1920 *taungya* plantation of teak, 3 years old.

2. 1921 *taungya* plantation of teak, 2 years old.

3. 1921 *taungya* plantation of *Gmelina arborea*, 2 years old.

4. 1922 *taungya* plantation of *Lagerstroemia Flos-Reginae* 9 months old.

Photos by M. C. Chowdhuri, P.F.S.

put along the bank of the Kaptai river, but no pure *jarul*. The *gamhar* area was thinned in 1921 and shows excellent growth. The teak was badly defoliated in 1921 and again in 1922. The average height of *gamhar* in pure patches is more than 50′ and girth 2′ 10″ and over. The height of teak is nearly 30′.

1920 :—The area of this year's *taungya* at Kaptai is 185 acres. The entire area was sown with teak at the beginning but the teak failed to germinate well on account of drought, so the area was resown with *gamhar* and seedlings of *toon* and *chakrasi* were transplanted in blanks. Now it contains about 70 per cent. *gamhar* and 30 per cent. teak. The area is fully stocked and the growth of *gamhar* and teak is very satisfactory. Cutting of double stems and cleaning were done in 1923. The average height of teak is 25′ and *gamhar* 30′. In this year experimental *taungyas* were tried in other ranges, 20 acres in Kassalong and 5 acres in Ringkhoong Range. They are also very promising.

1921 :—*Taungya* plantations were made in three ranges, 138 acres in Kaptai, 50 acres in Kassalong and 8 acres in Ringkhoong. *Jarul*, teak and *gamhar* were sown in pure patches. *Jarul* is doing very well, *gamhar* had formed a complete leaf canopy in 1923. In this area, the cutting of double stems was done one year earlier than in the other *taungyas*. Accessory species have been removed where they were interfering with teak. A pure patch of *jarul* sown 4′ × 4′ formed a complete leaf canopy after the second year and the height of the plants is now more than 10′. Defoliation of teak was very bad in the first and second year, hence the growth of the teak is not very good. The average height of *gamhar* is over 20′ and teak 15′.

1922 :—*Taungya* plantations were again made in three ranges 119 acres at Kaptai, 50 acres in Kassalong, and 20 acres in Ringkhoong. The sowing was done in the same way as before. At Kaptai more *jarul* was put out than before. The plantations are successful and the teak in the Hill portion is very promising. The height of the teak plants in July 1923 is nearly 10′. *Gamhar* is also doing well.

1923 :—This year's *taungyas* consisted of 115 acres at Kaptia, 50 acres in Kassalong and 25 acres in Ringkhoong Range.

Owing to the drought germination of seeds at Kaptai was not very good, but 70 per cent. had been filled up by the end of July 1923. The Kassalong *taungya* was more successful. It was made late, but the area was fully stocked by the end of August 1923.

Growth—gamhar :—A sample plot has been started in the 1918 *taungya*. The sample plot was thinned once in 1920 and again in May of 1923, that is at the age of 5 years and the following results obtained :—

The average diameter per tree is 5″ and height 51′. The biggest tree has 7·45″ diameter and the tallest tree is 59·5′ high.

I also compared the rate of growth in thinned and unthinned areas in the same year's *taungya* by taking girth measurements of 50 trees in each.

The average girth per tree in the thinned area is 18·3″.

The average girth per tree in unthinned area 14·75″.

If this rate of growth is continued, we can easily produce 6′ girth trees at Kaptai within 30 years.

Teak—Sample plot in 1922 *taungya*.—This *taungya* is 11 years old and from the sample plot the following figures were obtained :—

It has been thinned twice and after the last thinning the number of stems per acre was 289 and the average mean girth at 4½ from ground 18·6″.

Volume per acre timber over 1′ 6″ girth—832 c.ft. and small wood 688 c.ft. Total 1,520 c.ft. per acre.

Sample plot in 1922 *taungya*.—This is a height growth sample plot. The age of the *taungya* is 6 years.

The average height is 45′ and the tallest tree is 58′ high. There are two other sample plots in the same area started in 1923, one in thinned and the other in unthinned area :—

The average girth in the thinned area is 12·3″ for 6 years.

The average girth in the unthinned area is 11·0″ for 6 years.

Chitmorum sample plot.—This is an old regular plantation :—

The age of the plantation is	...	31 years.
Number of stems per acre is	...	113

Mean girth per tree at $4\frac{1}{2}'$ from ground level is	...	36·4″
The mean height of the crop in feet is		80
Timber over 1′ 6″ girth is	...	2,798 c.ft. per acre.
Small wood ...	...	441 „ „
Total timber and small wood	...	3,239 „ „

From these three sample plots we find that teak if regularly grown will reach over 7′ in girth in 50 years.

In Chitmorum sample plots there are two *jarul* trees, the average girth of which in 31 years is 32″. So *jarul* over 72″ girth can be grown in 80 years in the Hill Tracts.

The statement below shows the cost of the *taungya* plantations made up to date in Sitapahar Range :—

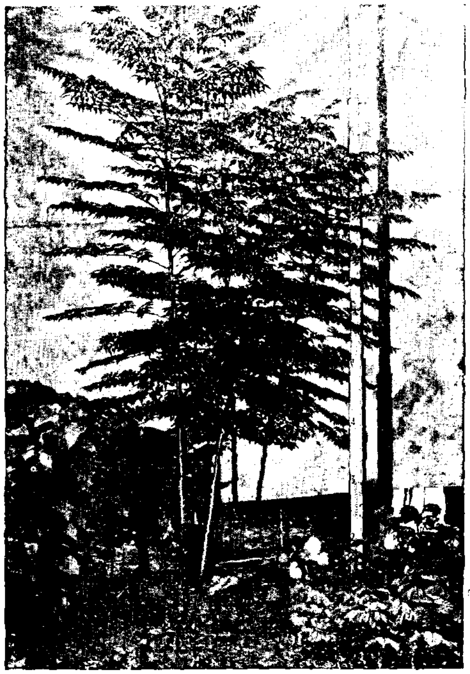
Taungya.	Area in acre.	Age.	Cost to the end of 1922—23.	Average per acre.	REMARKS.
			Rs. a. p.	Rs. a. p	
1912	10	11	758 0 0	75 8 0	More money spent at the beginning for extensive cleaning and thinning instead of periodical thinning.
1913	10	10	1,251 0 0	125 0 0	Do. Do.
1917	20	6	319 0 0	16 8 0	Periodical thinning done.
1918	80	5	1,352 0 0	17 0 0	Do. Do.
1919	78	4	2,153 0 0	27 9 0	It was full of jungle and weeds in 1920 and special cleaning was necessary to save the *taungya*.
1920	185	3	2,912 0 0	15 12 0	...
1921	138	2	2,162 0 0	15 10 0	...
1922	119	1	613 0 0	5 3 0	Tending and rearing not paid fully.
1923	115	...	...	...	Started this year.

M. C. CHOWDHURI, P.F.S.

NOTES ON SOME QUICK GROWING SPECIES WITH SPECIAL REFERENCE TO FIREWOOD SUPPLY TO TEA ESTATES IN DARRANG DISTRICT, ASSAM.

The district is studded with Tea Gardens. These gardens require firewood for various purposes, the most important being for the use of their coolies. This demand alone is considerable when it is remembered that Tea Garden coolies form nearly 80 per cent. of all those who labour for wages in Assam. Actual wooded area of the Unclassed State Forests of the district has practically disappeared; uncultivable grassy blanks are all that has been left behind. It was to prevent destruction of the wooded area of Unclassed State Forests altogether, that village forests were constituted. It was, however, too late. Mr. F. H. Todd and Mr. W. R. Le G. Jacob had therefore had to draw the attention of their Divisional Forest Officers and the planters (through articles published by them in the *Indian Forester* of February 1923) that the shortage of the firewood in some districts, and notably in Darrang was becoming serious. The duty of suggesting suitable plants and convincing the planters of the advisability of making plantation of their own however fell on Captain G. A. Nevill (Political Officer, Balipara Frontier Tract), who relieved Mr. Jacob of the charge of Darrang Forests Division.

Under the direction of the said officer experimental nurseries and plantations were made. Some of the data were collected from outside. Of the species tried it may now safely be stated that (*i*) *Albizzia moluccana* (Ceylon Saw), (*ii*) *Cassia siamea*, (*iii*) *Melia Azedarach* (*bokain*), have proved very successful, and in fact they are likely to do well in other plain districts of the Province. *Albizzia moluccana* has been grown by the planters of Sibsagar district as a shade plant to tea. In Darrang it has done equally well if not better; probably due to more sandy nature of the soil of this district. The first two species are not indigenous of the district, but they grow so well and their natural regeneration is so prolific that probably it would not be a mistake to suppose that undue importance is sometimes given to the so-called "natural home" of species. As yet little is known about the suitability of



Melia Azedarach (*bokain*) 6 months old.

Albizzia moluccana 5 months old.

Cassia siamea one to two years old.

different species in different localities. The remarkably rapid growth of the species mentioned will be amply testified from the photos.

Artificial regeneration of these species is comparatively inexpensive and is very easy. One thorough weeding by the middle of rains, is quite enough to give them a lead above the surrounding grasses or other herbaceous growth. Sowing 12′ × 12′ would make a nice crop to start with, and will kill the grass in a couple of years time. Grassy blanks can be quickly afforested by these species; and their (*A. moluccana* and *Melia Azedarach*) light canopy would afford a shelter for other slow growing evergreen species to follow as an under crop. For the purpose of restocking a few mother trees, left at suitable intervals, would ensure complete replenishing of the crop removed in the course of 3 or 4 years. Trees 4 to 6 years old attain sizes big enough for felling for the purpose of fuel.

As to their reputations about soil improving power, there are evidences that the shallow surface soil of the " Savanna land " unfit for cultivation has been made suitable for " Tea " by enriching the soil and increasing its depth, within 3 or 4 years of the advent of these species. However this improvement is more mechanical than chemical.

Ordinarily they are not browsed by cattle such as cows and buffaloes, but the ubiquitous and all-devouring goat would not mind nibbling the tender seedlings now and then ; neither could I give any guarantee for cows, as a certain cow was reported to have eaten up a Government file completely at Sylhet ! Most of the gardens have villages near by, and it may therefore be necessary to fence up the plantation or keep a strong watch to keep off the cattle; as the damage is often of a worse nature when a herd is allowed to roam freely and trample the seedlings than that by the browsing of a stray cow or buffalo.

As to their calorific value, I am not sure if they are very low, but according to Gamble *Cassia siamea* was at least once the chief fuel for locomotives in Ceylon. *Albizzia moluccana* and *Melia Azedarach* may not have the same heating value—but

surely they will do well for the purpose the planters chiefly want them for.

From all reports to hand (Prof. Troup's note and Mr. J. W. Bradley's note published in the *Indian Forester* of December 1922) and from the result of our experiments and observations Captain G. A. Nevill has recommended growing *Albizzia moluccana*, *Cassia siamea* and *Melia Azedarach*, on comparatively low and moist soil. Of these *bokain* is very hardy and thrives even on incredibly poor soil and on newly formed "Savanna land" bordering on the Brahmaputra. *Albizzia moluccana* should be selected for localities which have a little heavier soil.

A. K. ADHIKARI, P.F.S.

MORIBUND FORESTS IN THE UNITED PROVINCES.

A good deal has been written by various Forest Officers about forests in which the dominant species have for many years failed to give any satisfactory reproduction or in many cases any reproduction whatever. At first the popular reason for this, which is found set forth at length in many of the olden working plans, was maltreatment in the past, overfelling, burning, excessive grazing and the like. Later another reason was ascribed, based on the idea of alternation of crops that a certain area having for years produced many crops of trees of a particular species became in time unfitted for the production of that species and that in the course of nature that species would gradually die out and be replaced by some other. There is probably a great deal of truth in both of these explanations, but probably neither of them, nor both operating simultaneously, fully explain the condition of some of our forests at the present time. Undoubtedly the former has gone a long way to ruin many of our forests in the past. From the past history and from observation to-day many areas can be seen which were almost irretrievably ruined before they ever came under the control of the Forest Department. A case in point is the Bhinga Sal Forest in the Bahraich District. A working plan was written for this forest about 34 years ago. The area is described as having been heavily overfelled,

frequently burnt over, heavily over-grazed by villagers' cattle, and also overrun by herds of wild cattle. The standing crop consisted of scattered old hollow Sal trees with an almost entire absence of boles and regeneration. It was hoped that with protection from grazing and burning and by making only light Improvement Fellings the condition of the forests would gradually improve and regeneration would come in. Fire protection has not been entirely successful, nor has closure to grazing, as much illicit grazing has occurred. Fellings have, however, been carefully restricted to the removal of very over-mature, dead and dying trees only. However, with the exception of a small area in the middle, where there are a few poles and saplings, the state of the forest now is no better than it was described to be 34 years ago. So the first explanation does not seem to meet the case. Practically the same applies to the southern part of the Motipur Sal Forest, also in Bahraich. Here, however, closure to grazing and fire has been much more successful than in Bhinga and the standing crop in much better condition, but in spite of years of protection and careful management regeneration is entirely lacking and over large areas nothing but valueless *bael* (*Aegle Marmelos*) exists. Generally sal trees die round the circumference of the *bael* areas and the latter extends.

As regards the alternation of crop theory this is much more difficult to argue about and it is not proposed to say anything more about it, except that there is probably another explanation which accounts for the state of many of our forests.

It must be remembered that at first there was an idea that there was unlimited forest wealth in India and for years nothing was done to protect forests in any way. Finally the wholesale clearances that had taken place and the difficulties found in procuring sleepers for Railway extension made Government realise the fact that forest protection was necessary. This however did not take place until a very considerable area of forest had been entirely cleared and a further considerable area irretrievably ruined. To show the extent to which this had progressed two instances may be quoted. The present reserved forests in the Gorakhpur District consist only of grants to individuals that lapsed back to Government through the grantees failing to clear

the land in the specified time. There is a map in the possession of the manager of the Lehra Estate which shows that part of the District was practically one vast forest whereas the present reserves consist of only small disconnected areas. Similarly in Bahraich district the present forest consists of tongues stretching southward from a vast forest, the greater part of which was handed over to Nepal after the Mutiny and most of which has been subsequently cleared. Old residents of the district also remember when the whole area was very heavily wooded.

Such wholesale disforestation must have made a considerable difference in the climate and natural conditions and the comparatively small areas left as reserved forest must have suffered adversely to a considerable extent. Coupled with this come the shifting of water courses, the excavation by rivers of their beds and the consequent lowering of the water level. The Motipur forests above referred to are situated on a long high strip of isolated land, varying in width from one to about three miles. The high bank, in places 40 feet in height, on the west is obviously the old left bank of the Gogra, which must have at one time flowed close to the western boundary of these forests, but is now some ten miles away further to the west. On the east also there is another high bank, not so well marked as on the west, which is the old bank of the local Sarju river. This has also in many places cut further away from the forests to the east. So the central and southern portions of the forest now lie on a high narrow isolated strip of land in which the natural conditions must have changed considerably in comparatively recent years. The more marked changes are a lowering of the sub-soil water level, a decrease in moisture, and excessive drainage.

So in this case certainly natural conditions, it may be argued, are alone sufficient to explain the fact that although this area formerly supported a good crop of sal it is now rapidly ceasing to be able to do so, and may be considered a moribund sal forest.

In Bhinga also much the same applies. On the south there is the Rapti, which although it has not excavated its bed to any extent and still floods considerable areas of country in the

monsoon, still has a bed whose dry weather level is considerably below that of the forest. Here also we have a moribund forest, due to a change in the natural conditions of the surrounding country but in this case probably also considerably affected by past maltreatment.

Probably also similar reasons may be ascribed for the state of other areas such as the Jaspur Range of the Ramnagar Division and the low-level sal forests of North Kheri.

In Gorakhpur the question is somewhat different and most of the bad forest there is probably due to water logging of the soil. The general natural drainage of this district is rather poor. The streams that run through the forest are slow sluggish streams which when in flood deposit silt on their banks at varying distances from their beds, thus forming in places a continuous high bank between their beds and their natural drainage areas. In this manner water logging is caused in the areas away from the streams beyond their high bank. This was first pointed out to the writer by Mr. R. G. Marriott some years ago. With the excessive clearing that has taken place and the conversion of many of the natural drainage channels into rice fields with high "*bandhs*" the ordinary drainage of the country has been considerably interfered with. It would seem, however, to be another case in which a change in the natural conditions has adversely affected the forests.

From all this the only outstanding fact remains that in the United Provinces we have a considerable area of moribund sal forest, which, owing to changes in the natural conditions of the country and to the fact that the destruction of the forests was too widespread before any effort was made to protect the forests, appears to me to be likely to disappear as sal forest, in the future.

W. A. BAILEY, I.F.S.

EXTRAORDINARY VITALITY OF A WILD DOG.

Before I commence my story I draw attention to the praises bestowed on the ·405 rifle by various sportsmen and arms-dealers. It is a high velocity rifle, said to have been used by President

Roosevelt for all big game shooting in Africa. It is called a "medicine gun" for lions and a "stopper" for tigers. It is recommended as the second best weapon for big game shooting by the well-known author of "Shikar Notes" for those who cannot afford to possess the costly double-barrel rifle. I have used it on the toughest hide of "mugger" under one foot of water, at a distance of 100 yards and the bullets simply shattered the monster's brain to pieces; and yet I had the following very strange experience with a wild dog.

On 3rd December 1923, I received instructions from my Divisional Forest Officer to inspect a certain road from the Forest Village of Pipalgota and to report the result to him in the evening. It meant a journey of 15 miles and back, so I started at 4-30 in the morning, with a Forester and one villager. I asked the villager whether I should carry a shot-gun or a rifle. The choice naturally fell on rifle owing to the prospects of shooting a blue bull. When I had almost passed the part supposed to be full of blue bull I questioned the villager about the absence of these animals on this particular day? Just when the villager was in the act of expressing his surprise, Lo! on the right side of the road, I found the cause of it—a wild dog. At 100 yards owing to the dim light I took him for a jackal and I asked the villager if it was not a jackal. He said that it was a hyæna. On nearer view at 40 yards we all unanimously declared him to be a wild dog. As soon as this fatal judgment was pronounced, a soft-nose bullet from my ·405 rifle laid him low. Just after this I got a faint glimpse of half a dozen wild dogs disappearing into the nearest cover. I had a long journey to perform and so was not inclined to undertake a wild dog chase.

The bullet entered on the right side, about 2 inches behind the ear, and passed through, after doing great damage on the other side. In the evening my Divisional Forest Officer examined the tissues damaged on the side and measured the wound inflicted which was not less than two inches in radius at the point of exit.

The dog with such a terrific wound within a few inches of the region of the brain, got up and started running in circles but

dropped down at every few yards. I took a bamboo stick from the cart driver and gave the dog 5 or 6 blows on his head. He cried out and apparently gave up the ghost. We picked up his dead body and placed it in the cart and resumed our journey. After going 3 miles further, I shot a nilgai. Equidistant from both ends of my journey there was another Forest village Jatamao, which is at least 6 miles from the place where I shot the dog. I had to change the bullocks of my cart here. My Forester and other villagers suggested that I should leave the dead body of the dog at this village, and pick it up on my way back. I readily agreed to this proposal and asked the people to unload the body. As soon as the body was lowered on the ground, the dog recovered consciousness again and off he went, galloping away as if chasing after a samber. In a minute, he was gaining the nearest thicket and I would have lost him for ever, had it not been for two village dogs who chased their wild brother and pinned him down. I sent the Forest Guard who, with the back of his axe, bashed in the head of the wretched creature. What would have happened if this had been a tiger being carried home?

Recently I read a most interesting article in the *Indian Forester* by Mr. Mitchel in which he expressed his surprise at losing a wild-boar shot through the neck with a high velocity rifle. Such instances are very common and the moral is, never approach apparently dead carnivora from in front, even when you think that you have shot them through the most vital part or you think that you have hit the animal with a rifle of which you are confident of. Many a sportsman has lost his life under this delusion.

The villager narrated a strange story about wild dogs. One day, 5 years ago, a tiger killed a young village buffalo in the private forest adjoining Betul reserve. When the tiger was still on the kill there came a pack of wild dogs about 40 to 50 in number; within a few seconds they surrounded the tiger and pulled him down and after an hour nothing was left of the tiger except his head and the buffalo-kill remained untouched!

I have no reason to disbelieve this story from a simple man, as I know of two instances, from very reliable persons of tiger and panther being "*treed*" by wild dogs, both in Rahatgaon Range of Hoshangabad Division.

Ten years ago, Muhammad Karim, Patel, a forest contractor and land-owner, witnessed a strange scene in coupe No 28, Uskalli Felling Series, when he saw a pack of wild dogs circling round a tree, and a tiger sitting in the fork of this tree, about 6 feet from the ground.

A Forest Guard and three forest villagers saw a panther in a similar position in coupe No. 4, Dong Felling Series, about 8 years ago.

I cannot wind up the story without mentioning the fact that the reward for killing a wild dog has been recently reduced from Rs. 15 to only Rs. 5 in Central Provinces. I have been told that one gets Rs. 50 for killing a wild dog in United Provinces. Who can find out the cause for such a great desparity between two adjoining provinces? Well perhaps with the advent of "Reforms" the wild dogs of these Provinces have also reformed themselves, and left behind their brothers in the United Provinces???

S. R. DAVER, P.F.S.

THE STUDY OF WOOD*.

By Herbert Stone, M.A.

Since the coming of the iron ship the study of wood had been steadily on the decline, until in comparatively recent years it has again been taken up by the Department of Agriculture of the U.S.A., which has now placed it upon the footing of a principal subject. In the interim, wood had been regarded as a troublesome addition to the work of the Physical Laboratory where its eccentric behaviour afforded little satisfaction, and gave rise to so many reservations, or else it became an almost equally neglected part of the botany course. Even at Cambridge timber technology is only nominally recognised, being merely an

* Lecture given to members of the Great Eastern Civil Engineers' Society, by Herbert Stone, (Hon.) M.A., Lecturer in Forestry, Univ. Cambridge.

"optional" subject. At other Universities it is generally merged into more general subjects, such as "Forest Utilisation." At the moment some attention is being paid to it by certain Government departments, with meagre results up to the present.

The wooden-ship yard was the great nursery of this study, and from the time when Galileo visited the Arsenal at Venice, where he gained the ideas which led him to formulate his law upon the resistance of solid bodies, the dock yard occupied practically the whole field. Amongst great names in this connection the following should, out of gratitude, be recalled—Duhamel du Monceau, John Knowles, Peter Barlow and Thomas Laslett. The architects come next, but, notwithstanding that their daring use of wood implies profound knowledge of its physical properties, they have left few written records of the craft.

Leonardo da Vinci made the first tests of materials, and Alberti left two pages upon wood in general. Amongst amateurs who should be mentioned are the Comte de Buffon, the friend of Duhamel, then after a long interval, Chevandier Wertheim, Pacinnotti, Peri, Nördlinger, and the three Hartings. There are no English translations of the works of *any* of these authors. Since the close of the eighteenth century no new principle (except perhaps one small one) has been discovered, all progress being by way of the accumulation of detail, in which the American school have done immense service.

We, in England, will never be large producers of wood, but we are large consumers, and in this respect the railway engineer takes no small part. He is, however, interested in a section only of the subject, for the number of uses to which he may put the wood is limited, as is also the number of species that he employs.

I shall exclude all ornamental woods, notwithstanding their application to carriage-building, and shall confine myself to considerations of resistance to external forces, inspections, etc.

That wood is superior to iron for many purposes is well known, but perhaps a detailed list may be worth quoting from Roth (1896, pp. 391—420):—Cheapness, softness, fissibility, strength in proportion to weight, elasticity, absence of permanent set,

lightness in respect to transport (floatage, etc.), low conduction of heat and electricity, low expansion with heat, absence of rust, inoffensiveness (of many species) in contact with foods and drink, absence of action in contact with certain metals (*e.g.*, elm with tinned plate), variety of surface adhesion to glue, and uses as fuel pulp, and for distillation.

From the foregoing it will be seen that wood will always play a great part in our daily life. For all the trouble it may cause you, you will still retain the wooden sleepers; you may bury your wires, but for the most part you will retain the wooden telegraph pole, and the iron truck does not seem to be displacing the wooden one. On the other hand, our temperate forests are so rapidly disappearing that the increasing use of iron is a matter for congratulation to the user of wood.

GROWTH.

In order to understand the behaviour of wood under all circumstances it is necessary to know something of its structure and why it is not an isotropic material.

A little tree-seedling at the end of its first year looks like a thin twig of a few inches in length. If the outer coat be stripped off, a cylinder of wood will be seen within. During the stripping process the fingers will become sticky with the debris of the delicate growing-layer (known as the cambium), which lies between the rind and the wood. The stickiness is due to the protoplasm, the seat of life in the tree, which is enclosed in microscopic fibres that produce new wood-substance on the inner side, and bast (in smaller quantity) on the outer. At the end of the second year's growth such a seedling will show a new extension in height (the leader), practically identical in structure with that of the first year, and an increase in thickness of the lower part of the stem.

Here dissection will show a new cylinder of wood, enclosing the old one, which lies inside, quite unchanged, *i.e.*, the first year seedling has taken no part in the new formation, the cambium having simply overlaid it with a new sheath of wood. Under certain circumstances the original seedling may be withdrawn

entire from this sheath. In the third, and all following years another layer is added, and so indefinitely. A tree may be described as a sort of Chinese puzzle-box, from which, on removing cover after cover, other similar but smaller boxes are brought to light. Leonardo da Vinci first pointed out this manner of growth (about 1510). He says ("Della Scorza degli Alberi," p. 5): "The increase in the diameter of trees is caused by the sap, which is produced in April, between the shirt and the wood in the tree."

As the tree is a long, tapering object, this method of growth results in a body consisting of a number of concentric cones, and upon this fact depends much of its behaviour towards external forces, because each layer is somewhat feebly attached to its neighbours within and without. A familiar example is the "shelling-out" of certain layers in floorboards, that turn up and catch the feet when the carpenter has laid the boards wrong side up. To coin a phrase, there is a "zone of weakness" between each layer of wood. Amongst the different species which concern us here, there are two great groups, *i.e.*, those trees which have needle-shaped leaves (conifers such as pine, spruce, and fir), and others which have broad leaves (oak, beech, elm, etc.). The two groups differ as much in their wood as in their foliage, and that which is true of the coniferous woods is generally inapplicable to that of broad-leaf trees. Slowly-grown coniferous timber is of the better quality, whereas the faster the broad-leaf wood is grown the better it is.

The reason is this: In the earlier part of each year's growth the conifer produces spongy material, and dense material in the summer.

During a good growing season the amount of lax substance greatly outruns that of the denser layers, which rarely vary very much, so that in rapidly-growing trees of this kind the bulk of the timber consists of delicate, easily ruptured tissue. On the other hand, when slowly grown the lax tissue is reduced to a minimum, while the hard zones remain much more constant in size, and follow each other at more frequent intervals: there are so many more of them to the inch. This is the reason why

English-grown conifers produce such inferior wood (larch excepted). They grow only too well, and to obviate this foresters must plant the trees so closely that their growth is retarded, but then the production of timber is so much diminished that such forestry becomes unprofitable.

In the broad-leaf trees the spring growth may be lax, but it comes to an end so soon that the extra increment which takes place during a good year is of hard substance. The soft spring wood is approximately the same in all years, any variation in the thickness of a layer being put to the credit of the more desirable wood, and this variation may be as 1 is to 50. In selecting timber specify *many* layers per inch for conifers (softwoods, as they are termed in the timber trade), and *few* layers per inch for broad-leaf timbers (hardwoods).

There are exceptions to every rule, and nature especially refuses to abide by any law. To enumerate exceptions where they are so many would be tedious, but I must not omit to mention an intermediate group of trees (partly of each class) where the product of the whole growing-season is so uniform in quality that it is indifferent whether the tree be fast or slowly-grown (beech, etc., see below). I will sum up as follows:—

Pine-like coniferous woods:—Best quality when slowly-grown (many layers or rings per inch); pores rare or none—pine (red and yellow deals), spruce (white deal), pitch pine, Oregon pine (British Columbia pine or Douglas fir), silver fir (the Sapin of the French).

Broad-leaf woods:—Best quality when fast-grown (few rings or layers per inch): A zone of readily visible pores in the inner side of each ring—Oak, ash, elm, chestnut, acacia, teak.

Both classes:—Rate of growth indifferent:—Conifers of the cypress-type (little importance). Broad-leaf trees, such as beech, birch, sycamore, maple, poplar, willow.

There is no set limit to the age of a tree; it has no adult stage. Theoretically we may assume that a time must arrive when the roots and the leaves are so far apart that they are no longer able to nourish each other, but as regards the highest and oldest trees known, the Wellingtonias or Sequoias, the

physiological limit is still unreached. Pinchot (1900, p. 19) says that "barring accidents, they seem to be immortal. I have neve seen a 'Big-tree' that has died a natural death."

Qualities and Defects.

The engineer demands certain virtues of his timber: sufficient resistance to external forces, such as compression, tension, transverse strain, elasticity, toughness and certain minor qualities, then good quality for the species, good condition, dryness and good manufacture.

For this reason it is as well that the engineer should be able to judge of the four last-mentioned by inspection, the quality of the species by reputation, and the rest by testing. I will take each item *seriatim*.

Quality.—The number of rings per inch has been dealt with but I suggest not less than 10 per inch for conifers, and not more than five for broad-leaf timber, both taken from an average over three inches of radius. When this has been done for a number of planks, the latter may be weighed and the weight per cubic foot afterwards used for the basis.

This must, however, be ascertained for each delivery, as the state of dryness is material in point of weight. Fortunately the desirable qualities of wood are found in company; hence hardness weight, freshness of colour, wholesome smell and ringing tone when struck, should all be elements in our judgment.

Defects.—Some defects in timber from a user's point of view are essential to the economy of the tree. Knots are of this nature; they are the inner ends of the branches, and are inevitably present, but in trees grown close together the branches are killed off early by the shade and die when small. They may form "live-knots," which are an integral part of the woody mass, and being harder should enhance rather than diminish its strength, but the fibres around them are deflected and run inwards and again outwards along the branch in a sort of "hair-pin" bend hence they may offer less resistance either to extension or compression.

Sound live-knots should therefore be allowed for as though they diminish the thickness of that part of the plank where they

appear, by half their own thickness, *i.e.*, an inch knot may be regarded as reducing the thickness of the plank by half an inch, but as the knot may not affect more than a part of the width of the plank the allowance should be according to the depth to which the knot penetrates. This may be evident, as in a "splay-knot" if a "face-knot," its depth may be known by the inspection of the end of the plank, inasmuch as no knot can reach further than the centre of the tree. Dead-knots are branches that have died and have been entombed by the subsequent thickening of the trunk. They are not attached to the surrounding substance, and can often be pushed out. The dead-knots may be regarded as holes, and should be allowed for as such. Live-knots decrease in diameter inwards, but dead-knots have parallel sides.

Species.—When only a few kinds of woods are used, the inspector can generally tell them at sight, but lacking the necessary practice, one should examine the end, not the sides, of the planks. Smooth it, if rough; a sharp knife will generally serve. The structure of most of our common woods is so characteristic that once seen it can easily be remembered, always excepting the conifers, for which the microscope may be needed.

SAPWOOD.

Sapwood is the unripe wood of the tree, and generally lacks all the good qualities possessed by the heartwood. It is always of a lighter colour, either white or of the tint of oatmeal. Before the preservation of wood became general it was essential that sapwood should be rejected for work demanding durability, but inasmuch as the sapwood takes creosote better than heartwood the former is now usually accepted. Its influence on durability rests upon the fact that the fibres of which it is composed still contain some protoplasm and more starch, upon which the fungus causing decay depends for its nourishment. There is no starch and but little protoplasm in the cells of the heartwood, but once the fungus is established it can convert the older woody substance to its use, and will find enough dried-up protoplasm in the heart for its need. Of the broad-leaf trees only those having a zone

of large pores in the inner side of the rings (in the spring wood) form heartwood, *e.g.*, oak, elm, chestnut, acacia, teak.

Sapwood is rarely seen in the two latter it is very narrow in the chestnut (about ¾ in.) but very wide in the oak, where it may be anything from 2½in. to 7in. wide. The sapwood of the elm is also wide, but it differs from that of all other trees that I know, in being almost as durable in wet situations as the heartwood, as witness the waterpipes so often dug up in the London streets.

Of coniferous (soft) woods, the spruce is all sapwood. The pines make heartwood, but it is now so difficult to obtain planks or even boards without sapwood, that the "no-sapwood" clause in specifications is no longer either a commercial or legal proposition. To demand all heart enhances the price out of all reason. Architects still retain this clause, but it is never carried out, and the Courts have held it to be unreasonable. As far as we are concerned, the sapwood of conifers, as with the broad-leaf trees is the more easily injected part of the wood, hence it may be accepted for creosoting. It is only when it is required for interior work, where creosote would be offensive, that it becomes of importance. As you must accept a proportion willy nilly, I counsel you to see to the ventilation of your buildings, so that there shall be no stagnant air anywhere.

The appalling prevalence of "dry rot," which must be causing losses of millions of pounds per annum, is certainly due to the increasing use of sapwood, but only when the buildings are damp. No one hears of dry rot in old houses, unless repairs or alterations have introduced it, but the old house was allowed to dry before it was closed Nowadays the tenants are in before the putty is set in the windows, and the walls, floors, fittings, etc., still reeking moisture.

Spiral Grain.—The cause of this is obscure but is said to occur in about 5 per cent. of all pine trees. I think that this proportion is far too low, in view of the extraordinary numbers of telegraph posts which show it. When used entire, such a tree may do good service, though much weaker than a straight-grained tree, but it should never be sawn up, as it has a breaking angle of

anything up to half a right angle. Axon (*Timber Trades Journal*, February 10th, 1923), speaking of aeroplane timber, says that "spiral grain was one of the chief causes of death amongst air pilots during the war." One wonders why it was used, as it is always possible, and even easy, to detect the defect in the log. Before cutting up, it is almost impossible to avoid noticing the small spiral cracks on the outside of the trunk when the bark is removed; but when planked up, the wood needs careful examination, especially in the case of conifers.

In any event, a small piece of wood cleft in the direction of the radius of the trunk will show a sort of "dog-tooth" fracture and the lie of the grain. Further small cracks are usually developed on the corners (edges) of the boards, the nature of which is unmistakeable; they run obliquely into both adjoining surfaces, as though a "chop" had been made with a knife. On the other hand, the cracks in straight-grained wood are always on the flats or ends.

Another result of this defect is the twisting of beams during drying; they ultimately come to rest on obliquely-opposite corners. Shrinkage in length, which is almost inappreciable in normal wood, becomes serious when the grain is spiral, and a beam may exert a push or a pull of considerable force, according to the humidity of the situation.

These remarks do not apply to that kind of spiral which runs both ways in turn, and which we call "double spiral." It may be seen on the stump of any elm tree that has been felled. The double spiral knits the wood together, and makes it less fissile. For this reason elm is used for the hubs of wheels, pulley blocks and dead-eyes.

Resin Galls, or cavities in which resin or turpentine may accumulate, may be regarded as holes, being of no significance except the loss of so much material. When they occur in rings, as in the Australian gums (eucalyptus) they may be serious, as they run for great distances, and may separate one part of the trunk from the other; they are, however, readily recognised in the ends of the planks by being in the form of small holes arranged in arcs;

Decay.—Any unaccustomed change in colour or smell should be distrusted; lack of brightness, dullness of tone when struck, patches or spots of colour or black or chalky-white are bad signs. These indicate that the tree was sick, or perhaps dead, before it was felled and the wood is therefore unsound. "Dead wood," as this sort is termed in the trade, will not of necessity introduce dry rot, insamuch as the mischief has been done by a species of fungus that will not live in sawn timber.

On the other hand, "red" or pink stripe is a sign of the presence of a dry-rot fungus that may still be living, and will revive, given the necessary moisture. The colour when seen on freshly-planed wood is a bright rose-pink, becoming brown in time after exposure to the light; hence it is difficult to distinguish from the natural colour of the heartwood of the pine. If the wood is lighter in colour towards the centre than it is farther out, a cut should be made to verify the pink stripe, because the natural colour of heartwood is deeper the nearer the centre it is produced. Pink stripe is found only in the pines (red and yellow deals). Another defect, confined exclusively to spruce, is "blue." This is sufficiently familiar to all who handle white deals, inasmuch as 5 per cent. of "blued" wood is accepted in every cargo, and some shippers manage to include 10 per cent., if we may trust the outcry in the trade journals. Except as an eyesore to the joiner, it is of no moment, because the fungus that causes it cannot continue to grow after the wood is once dried, indeed, it is said to make the timber tougher by replacing a small number of delicate cell-walls with a larger number of its own tough fibres. However that may be it is certain that the woodmen of the United States demand extra pay for the hewing of blued logs.

Heart Plank.—When the tree is young it usually has plenty of room to spread its roots and branches; hence it grows fast, and the centre rings or layers of its trunk will be wide (thick). As the tree grows larger it meets with the competition of its contemporaries, which have been growing at the same rate, and begin to close in and overcrowed the site. Hence there will be a core of lax wood surrounded by a thick ring of harder wood. These

will shrink in different proportions, and the core may shell out, or in any case will crack seriously when planked up. It is therefore usual to cut out the heart plank and sell it as an inferior grade (wrack). (It would be better to call it centre plank, to avoid confusion with true heartwood.) Something of the kind may happen even in a broad-leaf tree if it has been allowed to remain beyond its prime in the forest, until the centre is dry and brittle, but if the tree has been felled before it has become "stagheaded," the centre will be as good as any other part. Piles for hydraulic work are often made of logs just hewn square, hence containing the centre. The latter may "cork out" under the blows of the hammer; therefore let the pile be driven into the ground "head downwards" (butt end up), because as the tree is a series of concentric cones, it is safer to drive the cones *in*, rather than *out*.

Defects of Manufacture.—These will be obvious for the most part, so I need mention but one or two. If the timber be kiln-dried it is liable to two defects which are akin, *viz.*, "honey-combing" and "case-hardening," both arising from hasty drying. If the wood is allowed to dry before it has been heated all through to the temperature of the kiln and too much heat is suddenly introduced, the outside of the timber will be cooked and will become exceedingly hard and unyielding, to say nothing of being uneven on the surface. This is case-hardening. Its complement is "honey-combing," which consists of a multitude of hidden, spindle-shaped cracks that arise because the inner part of the wood goes on contracting as it loses moisture, but as the unyielding surface will not follow the interior wood is torn to pieces. If the surface of the wood is hard, harsh to the touch, and uneven, a piece should be cut off the end of a plank, when the honey-combing will be apparent. The same test-piece may then be slotted into a fork-shape, and if the wood be case-hardened the fork will spread, and if wetted, will close in again (see *Tiemann*, p. 115).

STRENGTH.

Your timbers must be sufficiently strong for their purpose. They must resist compression parallel to the grain when used for columns or piles, and transversely to the grain when used as sleepers. Experiment in the physical laboratory has taught us little that is useful in respect to the former beyond bringing out certain anomalies, such as the increase of resistance with increasing length and proving the impossibility of predicting the resistance of a wooden post. However, this is no doubt owing to the practice of using small test-pieces. I will mention only one case (Laslett, p. 111), where bars of wood 4in. by 4in. by various lengths, from 10in. to 16in., bore successively heavier loads as their height increased. The 10in. column crushed under 34·875 tons, while the 16in. piece supported 40·75 tons. The explanation seems to lie in the fact that the columns did not fail by true crushing, but by fission; indeed, all wood fails in this way, *i.e.*, by the separation of the fibres, which then bend. The shorter the column the more easily it will split, just as it is easier to cleave a short block than a long one. Speed of loading is another factor which leads to great differences in results, for the pace of loading one species or size will not of necessity serve for others. Allout and Miller (1923, p. 453) say that slow loading tends to give low results and rapid loading high results.

Compression perpendicular to the grain, as by a chair upon a sleeper, may amount to as much as one-third the thickness of the wood without injury to the latter, which will regain its original form. This will happen only with blocks compressed over their whole surface; if the pressure is local and the pressure plate or chair sinks into the wood, then shearing of the adjacent fibres takes place.

Wooden columns, of which pitprops are the commonest instances, fail either by "brushing over" at the ends, or by splitting and bending outwards, or by bending all one way without splitting. The two former are cases of fission, and the last is the same as a beam under transverse stress.

Timber is seldom employed in tension. Even in a "king-post" truss the failure occurs by the shearing out of pieces between the bolts and the end of the post; hence the size of such posts is usually absurdly exaggerated, as they may be replaced by quite thin iron rods. Although the tensile strength of wood as such interests us little, yet indirectly it is very important, inasmuch as in transverse strain the lower part of the beam is in tension. Experiments upon vegetable fibres, such as linen, flax, hemp, etc., which are practically of the same composition as the wood fibre, have shown that they are possessed of such prodigious strength as to take one's breath away on the mere reading of the figures. Without citing any, I may mention a practical instance related by Duhamel. After explaining that the immense rafts used in floating timber are made in sections which are fastened together by means of twisted hazel-rods pegged into holes, he says that on one occasion he saw a raft that had run aground pulled back into the river by a team of thirty horses without any of the hazel-rods breaking. A hempen rope will make a good show alongside a steel rod of the same weight and length. The fibres of wood are rarely longer than ⅛in., and cannot be separated and made into a rope without injury, so that investigators have used thin squares or strips of wood as tests, an inefficient method, as it is impossible to make strips without discontinuity of the grain.

On the other hand, the figures obtained will never exceed the reality, but will fall short of it; hence we may safely make use of them.

Of all the woods that have been tested up to the present time, none have shown a less resistance to tension than one and a half times that to compression, and of the woods in daily use two and a half times is the lowest proportion, and it may rise much above this. A simple experiment performed by Smart (1828, p. 220) demonstrates this difference. A lath supported freely at both ends broke with a weight of 11lb. A similar lath, secured both ends to a rigid frame, supported a load of 270lb. in fact, it acted as a rope would have done, for a piece of wood is literally a stiff rope. Tensile tests should be made upon thin

but very wide pieces in order to provide extensive clamping-surface, and the clamps should be very long. Pieces reduced in size in the middle, as used for metals, will usually "cork-out," and the slightest untruth in the lie of the clamp-faces will cause a side strain which may materially hasten the fracture.

The effect of the disproportion between the resistance to tension and compression may be illustrated by some of Duhamel's experiments. He took a number of bars of willow as much alike as possible. Six were broken for control, the rest were slotted from the upper side to various depths until some of the pieces were nearly cut in two. The slots were filled with plates of harder wood, and the little beams bore more when slotted than when entire, until a point was reached (at a distance of three-quarters of the depth) where the strength began to fall off. If the beams are entirely served and fastened together with a strip of hoop iron on the lower side they will obviously bear weight, the two separated pieces of wood above acting like the stones of an arch. Until crushing commences the beams cannot fail. This principle was largely adopted in the French dockyards in Duhamel's time. Structures in which lightness and compactness were of importance were made with members having a strip of hardwood laid in the upper surface to take the compression, and it is said that an economy in material and space of one-third was obtained. This teaches us that the vulnerable part of a wooden beam is the compression layer. No fitting should be allowed to injure the upper side of the beam. If you will examine any piece of wood broken transversely you will see that it wrinkled or "crissled" far into its substance, indicating initial failure by compression. With the ordinary testing-machine the same effect is seen, but more severely as the plunger sinks deeply into the wood, crippling it in the most vital part. All results from such machines are to be mistrusted. To minimise the injury the plunger is lengthened, but the test is no longer a centre test; it is a two-point test; besides this, the wood will generally break under one end of the plunger-plate, not in the middle. This defect is rarely allowed for, but when breaking large beams the Americans use an auxiliary girder with two plungers, which bear

on the wood at one-third from the ends. Each plunger is furnished with a maple-wood block to protect the surface of the test-piece, a good practical device, but it makes the case still more complicated, as it really becomes a four-point test.

Short beams (and long ones if they be deep) fail by longitudinal shear, and not by fracture—*i.e.*, they split lengthwise. This is as already said because the cones or layers of wood are feebly held together. Any result so obtained is no indication of the resistance to transverse stress inasmuch as if the ends of the beam were prolonged beyond the supports at both ends the adhesion of the layers would be reinforced, and the beam would bear a greater load, and would fail by fracture. No physicist has ever provided for this contingency, because they have consistently ignored the structure of wood. The fact that resistance to shear is a function of the area has never been taken into consideration.

The more layers of wood (the more rings per inch) that there are, the more planes of weakness there will be; by the law of chances alone a many-layered beam will be the weaker.

These layers of weakness have another important bearing upon resistance. If you examine the ends of a sawn plank you will observe that on account of the sawing the rings indicating the section of the layers are cut leaving arcs.

The layers so injured have less strength than their entire tubular form would impart to them. Secondly, when the beam is placed with the arcs more or less horizontally, the layers will tend to slide one over another as do cards in a pack when bent. If the beam is placed so that the arcs run vertically, the harder layers will take the stress, and there will be little tendency to shear, just as it is less easy to bend cards edgewise. Hence the same beam will support very different weights according to the way it is turned (orienté), which proves that the resistance of a wooden beam depends upon other things than its mere dimensions.

Wood varies in strength according to the state of humidity. A "green" or wet beam will fail under half the load it would

bear when dry. Water renders wood plastic, therefore all tests should be made on green wood and the size of beams calculated for loads at the maximum water-content which they are likely to acquire in a given situation, for wood is extremely bibulous, and will take as much moisture from damp air as it originally has at its fibre-saturation point.

Large beams never show the strength calculated from test on small beams, but very much less. The tree being a taper object, any wood removed by squaring must sever many of the concentric sheaths, some of which will not reach from one support to the other; these tend to burst away in large splinters. Various theories have been advanced to account for this difference; my own view is that whereas small test-pieces are usually dry, large ones are never dry in the middle, and are therefore more plastic.

It must not be forgotten that part of the strength gained in drying is due to a greater number of fibres being brought into the section by shrinkage.

A beam that will bear a given weight for a short time may break under the same (or less) if the load be left suspended for a longer period. A beam tested by Buffon bore without distress a load of 9,000 lb. for a day, but eventually broke under 6,000 lb. left suspended for six months. More recent experiments by Thurston led him to the conclusion that it is unsafe to use 50 per cent. of the maximum breaking-load in permanent structure. Some physicists prefer to have their calculations on the elastic limit taken at the point where the plotted curve departs from a straight line—*i.e.*, when the deflection ceases to be proportional to the load. This is relatively safe, but does not correspond with results obtained from experiments upon metal, because in wood the deflection, at first steady, becomes gradual, and then, once more, rapid. Further, as shown by Hennings (1910, p. 409), the deflection increases with time, even with so small a load as 1/15th, on the immediate breaking load. Kidder (1882, p. 132) obtained similar results, and states that a load which deflects a beam by one-half its maximum will ultimately break it. The solution

of the problem lies in the minute structure of the wood. To put the matter briefly, wood consists of a mass of spindle-shaped fibres, which are hollow. When the wood is stressed, the spindle-shaped bodies resist like so many little coach-springs, yielding proportionately to the load. A point is then reached when the wall of these springs are flattened together, when the wood may be regarded as solid. The subsequent resistance of this solid matter is quite a separate phase to the first. In other words, wood has two limits of elasticity, and if tests are to be of any practical service the first phase should be treated as being merely preparatory.

Heat renders wood plastic, as does moisture, but its application is chiefly in the bent-wood furniture industry on a small scale and on a large scale in ship building. Dry or moist heat, or both together, as in steaming, may be employed.

The margin of safety is purely arbitrary, and according to an American author (Johnson, 1896, p. 16), it varies according to our ignorance of the strength of the material and of the proposed load. Writing of the trestle-bridges of the U.S.A., of which there are still some 500 miles, he states that the margin of saftey varies from 0·6 to 25 times the calculated breaking strain. Rankine sets the margin at 4/5 times for dead load and 8/10 times for live load. Beyond this, all pure guess work, I have found nothing of any value in the literature of the subject. This may serve for the woods with which we are familiar, but the prudent engineer will not hastily accept any test of foreign and Colonial woods that are new to us without satisfying himself of their behaviour in practice.

All tests should be made with commercial sizes and the safe load so found restricted to such sizes, and not used as a basis of calculations for others.

As a rule, testing is left to institutions having the necessary costly plant, but there is no reason why you should not perform your own. Modern machines are beautiful things, and a pride to their possessors, but they fail in their object with wood of giving the results we need. They are accurate enough, but the plunger type does not afford the vital information. The

deflection accompanies the movement of the plunger. When the latter ceases to descend, nothing happens until the operator intervenes, whereas with a dead-weight the beam goes on bending independently of the will of the operator. When the point of maximum deflection is passed, the operator may continue to wind down the plunger, but the lever of the machine refuses to float hence he does not know what is happening. Then, the supports, if rockers, do not permit the test piece to lengthen as it bends. A piece which is at first 10in. between supports may be 13in. between them before the wood breaks; if rollers, they are pressed into the wood, and absorb much power. Chains or slings which close in, as used by Paccinotti and Peri, will circumvent this difficulty, otherwise one does not know whether to use the initial 10in. or the final 13in. as a basis for calculation.

I maintain that tests with beam supported one end are the only ones that will give true results with wood. They have been neglected, because they do not harmonise with those obtained with two supports.

May not the fault be with the latter method? When only one support is used there is no mauling of the specimen by the plunger, much less power is needed, the more so as any length of beam can be used at will; the deflection is far greater, which minimises error in reading off, and the curvature can be more easily studied, no part of the machine being in the way. The method that I recommend is to use boards as wide as possible in order to have the greatest sectional area without increasing the depth. Let the boards be also as long as possible, and clamp them "head downwards" to a column, to avoid the effect of sag. The stress can be applied to the lower end by means of a chain, pulley and dead weights. A board with squared paper can be set up close alongside the specimen, and the curve and deflection obtained by tracing a line upon it with a pencil guided by the edge of the test piece. Other refinements will suggest themselves. I am sorry to have to confess that I have no such machine. Want of funds! I have no column! Still, I have made experiments on a small scale by using Duhamel's simple contrivance, which consists of a carpenter's bench, upon which the test piece

is fixed by means of two dogs and the weights suspended to the other end of the board.

In this, however, the "own weight" of the wood comes into play, and there is much springing. Given the column, a flat plate of iron secured to it by bolts, and of sufficient area to take two feet of the end of a wide board will hold the wood without injury to it in any way. One result that will be found is that the beam will not break at the point of support, as assumed by most physicist from Galileo onwards but at some distance from it, on account of the flattening of the fibres described above.

I understand from a firm of telephone pole makers that poles usually break about 5ft. from the ground, but of this I have no direct knowledge.

Resistance to friction affects you only in such small matters as trenails, keys, and brake blocks. Some woods hold better than others. Oak is good, but acacia is better, being the best wood in the world for trenails, having been so used in shipbuilding for two hundred years.

It is grown in large quantities in Hungary, and small stuff should now be as cheap as oak. Acacia is practically imperishable, and does not require artificial preservation. In Italy this tree is planted on railway blanks to bind the soil together, for which its spreading roots are eminently suited.

Resilience is also of significance in the matter of trenails and keys. Here again, acacia and oak come first on account of the abundant layers of compressible tissue which alternate with hard zones of wood.

Resilience is also of importance in structures where shock is to be absorbed and distributed, as in the stretchers of a wooden bridge.

SEASONING AND PRESERVATION.

Two points of a different nature should be touched upon, *i.e.*, seasoning and preservation. Briefly, seasoning is not merely drying, it is the conversion of perishable substance in the wood into compounds which resist decay, and, indeed, augment the resistance of wood.

Drying, which means the evaporation of the water only, if carried out too quickly, will leave the perishable matter behind, unchanged. Heartwoods such as oak should not be dried too soon. I know one firm at Cambridge, the one generation of which lays down the oak for the next, but that is for the best work, and is too slow for these days of speeding up. In any case, do not cut up oak that has not been seasoned naturally in the log for at least twelve months. The tree is not dead for a long time after it is felled, and the natural process of the conversion of starch and sugar, which are perishable, into fixed tannin results in an extra dose of preservative matter, and at the same time getting rid of the food upon which fungi of decay depend for their existence. Thin stuff of the whitewoods, softwoods and sapwood trees, such as beech and sycamore, cannot be dried too soon, but they may *still be dried too quickly. The point which concerns you most* nearly is stacking, for bad stacking is responsible for bad timber as much as is any natural defect. The ideal stack-yard would be concreted and channelled, but failing this, all weeds should be cleared away by burning, and the site kept clear and free from scraps of old, decaying timber, which may infect the stock. There are many species of "stack rot" besides dry rot. Build the stacks on a slope, if possible, and in any case build them sloping, so that rain may not lie on the planks. The bottom row of the stack at least should be of brick or stone, ***never of wood.*** Each layer of planks should be separated by "stickers" of dry wood of *even thickness,* to prevent the green plastic timber from twisting and taking a set. If the timber be for ornamental purposes, the stickers should be of the same sort of wood, otherwise a stain may be caused. Rotten stickers must be sorted out and burnt. On the weather side of the stack the stickers should be flush with the ends of the planks, to keep out rain, and some covering of inferior but sound wood be laid on the top, in the form of a roof. Do not stack too densely; there should be an interval of 2-3in. between planks in one row, and ***only two planks*** in the next (at right angles), and so on alternately throughout the stack. It has been proved that close stacking slows dow

the drying very materially indeed ; it is surprising how sluggish the air may be even in a kiln.

Preservation.—You probably understand this problem better than I do, but I would impress upon you the necessity of thoroughly drying the wood before creosoting, inasmuch as the fluid sap is not miscible with creosote, and resists its entry ; the effective result of the process will be directly in proportion to the dryness of the timber. It is said (Weiss, 1913, p. 378) that about fifty times as much creosote is used as is theoretically needed to prevent the attack of fungi, but it is usually so badly distributed that a large excess is necessary. As you doubtless know, different sorts of wood exhibit extraordinary differences in their behaviour towards creosote, the spruce and Scots pine taking it best, white sweet chestnut practically rejects it (Havelock, 1907, p. 49). So far, we have no explanation for this phenomenon. I have heard of "saponified creosote" (¼ per cent. caustic soda added), the idea of Mr. S. H. Collins, of Armstrong College. It is said to make the solution much more penetrating, and to effect a great economy in creosote.

The methods suggested for the preservation of timber are as plentiful as black-berries, and many may be useful for indoor work, but for wood exposed to the rain, and hence to "leaching out" of solutions miscible with water, there is no rival to creosote. Foreign companies which still use other preparations do so simply on account of cost.—[*The Timber Trades Journal.*]

THE LAC INDUSTRY IN INDIA.

NEED FOR CULTIVATION AND IMPROVED COLLECTION.

[*From a Correspondent.*]

The lac industry in India, like many another Indian industry, is yet in an unorganised stage, despite the fact that India holds the word's monopoly in this article. The only other competitors are Indo-China and Siam but they are only competitors in the sense that they are the only two other countries in the world where lac is produced. The actual weight of their competition

with us is in the small ratio of 1 to 16 or $6\frac{1}{4}$ per cent of our trade. The point to be emphasised is not that India has a monopoly of lac and is, therefore, to be congratulated, but that India, though having this monopoly, is in the truly deplorable position of being unable to supply the world's demands. This is a point which cannot be sufficiently emphasised, for it means much for India, particularly in view of the fact that the lac industry is one of those industries which are in direct relation with the agricultural classes and consequently the greater the expansion in the lac trade the greater the benefit that will accrue to the agriculturists. This is a view of the problem which will appeal most to the economist and the Government and prove of only academic interest to the practical industrialist. The view, however, that will appeal to the latter is that the demand for shellac (prepared lac) is daily growing on account of its important uses in a number of industries, and consequently the greater the increase in cultivation and collection and the better the improvements in the methods of preparation, the greater will be the turnover and the profits. One other consideration which must weigh rather seriously with them is that should India lag behind and fail to meet the world's demand for lac and shellac, it will follow as a corollary that synthetic substitutes, however inferior in quality, will be used increasingly and a time may come when the whole lac industry and the big shellac businesses in Calcutta and London will be entirely wiped out, just in the same manner as the famous Indigo industry and trade were wiped out by the discovery of anhiline dyes. Here the question may be asked as to whether it would be a profitable industrial proposition to invest large sums of money in the lac industry and its kindred enterprises in view of the fact that synthetic substitutes are already in use and there is every promise of a truly first class synthetic imitation being put on the market in the not distant future by some plodding chemist in Germany or America. It is indeed a serious question, but it has a more than satisfactory answer in the important consideration that synthetic substitutes generally, or, as a matter of fact, as a rule, come into the market only under three conditions, namely, (1) when the natural product is not producible in sufficient quantities

to meet the demand for it; (2) when it lacks in any desirable quality or characteristic; (3) when it can be produced at a cost cheaper than that of the natural product. It will be clear that no synthetic substitute can possibly extinguish our lac industry and shellac trade, so long as we take care to keep pace with the demand by increasing our annual production and cutting down our rates (which are now subject to serious fluctuations and speculation) on that safest of all business principles, namely, large profits only on large volumes of trade.

To sum up, the position is that India being the greatest producer of lac should not abdicate that position and lose one of the best and most paying of her minor industries, but rather increase her industrial and commercial gains by keeping herself abreast of the demand and render efforts at synthetic production unnecessary and useless. The conclusion is simple enough that the position being such, the problem in relation to the lac industry in India simplifies itself into increased production of the crude article. The question of improved methods of preparation, though highly important in itself, is by way of comparison only of secondary importance.

METHODS OF PRODUCTION.

Those who are acquainted with the methods of lac production will at once admit that increased production of the crude material is only possible through the adoption of two methods, namely, (1) increasing production through the laying out of large plantations of such trees as are favoured by the lac yielding insect, (2) artificial stimulation of the host plants in the existing lac areas so that the insect might deposit larger percentages of the lac exudation. To these may be added the no less important considerations of improved methods of collection and supervision and more stringent clauses in the leases. But the first requisite is cultivation and conservation of lac yielding trees. And it is this central fact of the problem which we will discuss.

ENQUIRY COMMITTEE'S RECOMMENDATIONS.

The special committee appointed by the Committee for India of the Imperial Institute to consider the condition and possibility

of increasing the trade of the United Kingdom and other parts of the Empire with India in gums, resins and essential oils made the following recommendations in regard to the lac industry after an exhaustive enquiry assisted by experts :—(1) that the method of leasing concessions to collect lac should be improved and systematised, after an enquiry in India and that longer periods of leases and a sliding scale of royalties should be adopted, (2) that greater attention should be paid to improved methods of cultivation and collection of lac and that an advisory and supervisory agency should be constituted, (3) that one or two large scale Government factories should be started to put the manufacture of shellac on a thoroughly efficient basis and safeguard the interests of India and the Empire, (4) lac-ware manufactures should be encouraged in India, (5) that definite marks and grades should be established, in consultation with the Imperial Institute, to ensure the maintenance of standards of purity and quality, (6) that the system of trading should be simplified and more direct relations established between the Indian producer and the British user, because at present there intervened between the collector of the stick-lac and the actual industrial consumer of the finished article in the United Kingdom no less than seven persons, namely, the shellac manufacturer, the broker in India, the merchant and shipper, a banker, the London broker, the shellac trader and sometimes the small dealer and manufacturer of shellac varnish. The question of the greatest value at the present moment is cultivation and on this the Committee wrote : "The Forest Departments in India have given a good deal of attention to this subject, and good methods of cultivation and collection are available, but are not used to any great extent. An improved system of leasing would tend to a more general adoption of good methods. If the preparation of lac resin is in the future centralised in a few large factories, it will probably be easier than at present to ensure careful cultivation and collection as it will be to the interest of the owners of large factories to take all steps necessary to safeguard their future supplies of raw materials.'

A SUGGESTION TO GOVERNMENT.

The best and most satisfactory course to adopt would seem to be that for some time to come the Government should create a separate staff in the Forest Department to control the cultivation of host plants and collection of lac in *selected localities*. Dependence on contractors and lessees can never be fully successful, as their main object is to make the most in every season, regardless of all other considerations. The Forest Department should depute special staff to lac bearing areas, the main work of the staff to be the stimulation of the trees and the supervision of collection by the agriculturists, paying the latter at least 15 to 20 per cent. more than their present rates, so that they might thereby have an inducement to be extremely careful in collection. In other words, I advocate departmental enterprise as opposed to contract work, but only in selected localities. The next thing is for the provincial Governments to budget for special funds every year to be devoted solely to the propagation of lac bearing trees. Unless some such special effort is made, there is no possibility of any improvement in the industry. The burden is, of course, on the Government and it is never a satisfactory solution to an industrial problem to solicit Government management, but circumstances being what they are, it is impossible to recommend any other workable plan. As a matter of fact, if the Government decided on starting one or two model pioneer shellac factories to standardise treatment and brands, the suggestion I have put forward will be found to be of the highest practical importance. When once the industry is placed on a strong foundation and thoroughly organised, both with regard to cultivation, collection and preparation, industrial firms will of their own accord come forward to take up the Government factories and plantations. As things are at present, I do not think there is a single firm in India, engaged in the export of shellac which will be found willing to undertake the burden of cultivation and collection. The reason is simple. The merchants are all of them satisfied with what they are getting at present as all the lac produced in the country is taken up. There is room

for speculation in prices and "deals," and no one is consequently interested in going beyond the field and take up actual cultivation or collection work. Incentive in this direction is lacking and it is this incentive which the Government is called upon to give. It scarcely necessary to point out that the Government are bound to find every pie they invest in the development of the lac industry a profitable investment for themselves.

AN INDIAN CHEMIST'S VIEWS.

In regard to the question of cultivation of lac bearing trees and their stimulation to secure higher yields, I would like to bring to the notice of forest officers, and particularly the Dehra Dun Institute, a pamphlet on the subject written some three years ago by Mr. S. Mehdi Hasan, *chemist under the Industries Department* of H. E. H. the Nizam's Government. Not being an expert, I cannot, of course, pass any opinion on Mr. Mehdi Hasan's theory, which is opposed to all the accepted theories, but it is, however, one worthy of interest and it may be that he is correct in part, if not on the whole. "Chemical investigation has shown," he writes, "that those trees which are suitable for lac production, as a rule, produce gum, at any rate, in the bark. Further, it appears likely that tannins are the chemical precursors of gums. The question is, therefore, what are the trees and what the conditions of growth which produce gums ? Speaking very broadly, two main elements enter into the composition of plant food, nitrogen and carbon ; the nitrogen being absorbed by the roots from the soil and the carbon by means of the leaves from the C. O. 2 in the air. In inimical climatic conditions, like dry soil or hot sunny weather, and more so when both these factors occur together, the assimilation of carbon is disproportionately high. The tree is being forcibly fed with carbonaceous food in spite of the fact that it is suffering from nitrogen starvation and thirst. Such trees try a carbon starvation cure and exude gums and resins which are free from nitrogen thus keeping up a healthy balance between nitrogen and carbon constituents, which are free from nitrogen. Gum exudation is a sign of tissue waste and the plants producing these substances

must be looked upon as those which positively refuse to grow. Gum production is the right predisposition on the part of the tree towards attack by the lac insect. In order to produce gums we have to bring about a disproportionate activity as between the leaves and the roots, stimulating the development of the former and inhibiting the growth of the latter. Conditions of healthy root activity are well known to be air and moisture."

Referring to soils, Mr. Hasan writes: "We must select a locality where the struggle for soil food will be severest. Dry soils which produce coarse grasses which, in their turn, give rise to fires during summer and thus scorch further the neighbouring trees and alkaline or *Usar* soils which by the presence of salts tend to reduce the mixture capable of absorption by the roots, are the ideal conditions for lac plantations. As a matter of fact lac producing trees thrive on barren soils. *Palas* and *babool* are both salt loving trees. Soil bad for forest or timber growth or crop cultivation is the best soil for planting lac producing trees. *Palas* plantation has already been commenced as a means of reclaiming barren alkaline soils. Lac cultivation may, therefore, prove to be one of the best schemes for utilising areas at present uncultivated. Besides the choice of the right soil, there are two other means of predisposing trees to the attack of lac insects. Ultimately, it comes to two other ways of over-feeding, with carbon and under-feeding with nitrogen. One is scorching the tree by low ground fires, which stop the tree from vegetative growth and the stored carbonaceous material is thus utilised mainly for gum formation which is the probable food of the lac insect. Another way is to grow trees together while they are young and far apart as soon as they have sized, so as to induce them to grow lengthy. Crowding in early life hastens growth and thus brings about early maturity. So soon as they have reached an average height we must make the tree produce not a tall trunk but one with many side branches. Heavy side branches mean a huge canopy or a large leaf surface and by thus disproportioning the leaves as compared to roots we are increasing carbon assimilation to such an extent that the over-fed tree will suffer from nitrogen starvation and thirst."

I have given Mr. Hasan's views in full as they may be of interest to forest experts. Whatever may be the best method of cultivation, the fact remains that cultivation is a necessity and if it can be taken up on a large scale by special efforts the lac industry in India will at once take on a new lease of life.—[*The Indian Importer and Bazaar Trades Journal.*]

[Mr. C. M. HARLOW, I.F.S., Lac Research Officer, C. P., has written the following note on this article.—HON. ED.]

The correspondent who writes on the Lac Industry in India appears to have an excellent knowledge of the Shellac manufaturing industry. He has rightly emphasised its serious shortcomings and draws attention to the fact that unless the industry is reorganised it is liable to be extinguished, like the indigo industry, by synthetic substitutes. He indicates two problems, namely, to increase the supply of the raw product and to improve the methods of manufacture. We agree with him as to the necessity of increased supply but do not agree with him that by comparison the improvement in methods of manufacture is of secondary importance. The manufacturers are responsible for much of the present trouble, for the majority being small men of little knowledge of the world, adulteration is very rife. TN, the product produced by these small manufacturers, compared with the productions of the bigger firms, is filthy, dirty and adulterated. The consumers chief complaint is that each consignment of TN varies so much from another in its contents of dirt resin that they must work out a fresh formula for each consignment ; naturally they will turn to a chemical substitute when available, knowing that they can always rely on its compositions. We admit that the raw product is frequently put into the manufacturer's hands in a very dirty and adulterated state ; but the remedy lies in his hands and he must refuse to accept such produce.

In emphasising the importance of improving supplies and methods of collection the writer urges Government and especially the Forest Department to take the necessary steps in this direction. The Government of India has done its part and Commerce Department held an inquiry the result of which was the formation

of the Lac Association at Calcutta. To this Association Government gave the whole profits of its dealings in shellac as a munition of war and provided a handsome annual income by imposing a small export cess; in fact the Lac Association and Lac Cess are exactly parallel to the Tea Association and Tea Cess. The Lac Association has commenced work by building a laboratory at Ranchi and has already appointed a chemist and an entomologist who we understand are about to begin work.

The bulk of India's Lac is produced in Bihar and Orissa and the Central Provinces. In the former the Forest Department has established a brood farm demonstrating improved methods at Daltonganj while in the C. P. the Forest Department have begun departmental work on a large scale in many districts among which are Damoh, Raipur and Bhandara; we understand that the improved methods introduced have already served as an example in these localities and that the local cultivators in private lands have profited thereby.

It must always be remembered that the bulk of the lac bearing forests are in private hands and only 2—3 per cent. of India's lac is produced in the Government Forests. The suggestion that the Forest Department should plant lac trees is hardly necessary; for multitudes of trees exist on which lac has never been cultivated. The opinion has been expressed that if all the lac trees of Manbhum district alone were properly propagated with lac, the resulting crop would be far more than necessary to supply the world's demand for shellac. The greatest stumbling block to extension of cultivation and improvement in methods is the belief that cultivation necessitates taking the life of the insect. Though this is quite untrue that belief is sufficient to make the cultivation of lac abhorrent to the orthodox Hindu so that the actual cultivation is almost entirely in the hands of ignorant aboriginals.

The writer draws the attention of the Dehra Dun Forest Research Institute to a pamphlet on the subject of lac cultivation by Mr. S. Mehdi Hasan. We well remember reading this when it was published in 1919 and were much impressed at the time by the enthusiasm of the writer. We have not the pamphlet by us but so far as we remember Mr. Mehdi Hasan propounded the

ingenious theory that the attack of the lac insect is not a disease of the host tree but nature's remedy for an existing disease, gummosis; and that to cultivate lac successfully, gummosis must first be induced in the tree. Whatever Mr. Mehdi Hasan's experience may have been in Mysore and Hyderabad (where the lac insect is possibly a different species from that found in Northern India) his theory is not substantiated by facts in the C. P. where the healthiest *kusum* trees often produce the best crops of lac on first inoculation after pruning. We would invite attention to the late Mr. F. M. Howlet's remarks on the subject printed on pages 13 and 14 of Indian Forest Records, Volume VIII, Part I, Lac and Shellac. So far no general theory of the suitability of special soils for lac cultivation has been substantiated and we cannot subscribe to Mr. Mehdi Hasan's views that a barren soil is best suited to lac cultivation for one has only to visit villages in Manbhum and other districts to find the best lac crops on *ber* trees growing in the well manured excellent soils in the gardens round the villages.

In general we agree with the conclusions drawn by the writer on the importance of the industry and the necessity for improvement. The interest taken in the subject by the Government of India and by the Forest Department in the different provinces is perhaps not so well known as it should be.

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MACHINERY FOR JUNGLE SAWING IN INDIA.

When in India recently I found that in some quarters there was an impression that British makers did not lay themselves out for the manufacture of Saw Mills of a portable nature, but this is very far from being the case, as there are British firms who have devoted considerable attention to this during the last 25 years or more, and who are in just as good a position to supply suitable machinery of this class as the Americans or any other foreign makers.

No one can deny that the workmanship and material of the British machines are at least equal to that of America. Moreover the British manufacturers are, I consider, ahead of America with regard to machinery for dealing with hard Indian timbers in the jungle. There is a wide difference between tropical and the so-called hardwoods in Europe and America, and British manufacturers fully realise this.

I have been personally connected with the practical working of all sorts and sizes of Saw Mills in various parts of India and the East for some 12 years, a good part of which was spent in felling timber and sawing in the jungle. I can thus claim to be well conversant with Indian labour and the conditions under which machines are run in out-of-the-way parts of the tropics.

Returning to India last autumn, on a business tour concerning Wood-working Machinery, after an absence of several years, the points which struck me most were, firstly the enormous wealth of forest land still lying unexploited, and secondly the comparatively

little which is even yet being done to develop one of the most important if not the greatest asset in the country. The very thorough work which is being undertaken by the Forest Research Institute and College at Dehra Dun, and in a different manner at Bareilly will, I am convinced, help matters enormously in this respect.

A great deal of the machinery used in jungle sawing is moreover of a very crude and elementary nature. There are, of course, districts in which, owing to the hilly nature of the country or absence of proper roads near the timber centres, it is difficult to convey heavy machinery to the mill site. Therefore so-called "portable" machinery built up on wooden framing is employed which soon gets out of order and from which at least only the minimum cutting speed is obtainable.

In selecting their machinery prospective millowners not infrequently lose sight of the fact that to run it, unless water power is available, a more or less heavy engine is essential. Now a Portable Steam Engine of say 36 brake-horse-power weighs about 7 or 8 tons, or an Oil Engine of the same capacity 4 to 5 tons, and it is obvious that where these can be transported it is also possible to transport good solid all-metal machinery, of which the heaviest part for jungle work would seldom equal that of the engine even if the latter were dismantled. I am dealing, however, more fully with this subject later on.

Conditions, climate and transport facilities vary so very much in different districts of India that it is impossible to lay down any hard and fast specifications for Jungle Saw Mills which would be ideal for every part of the country. This article is, therefore, confined to the description of two simple portable outfits for the rougher classes of work, *viz.*, for breaking down logs up to 30" diameter and converting them either into railway sleepers, beams, scantlings, deals, or into such sizes as can be conveniently transported to a Permanent Saw Mill or Joiners' Shop and there converted into thin boards, or into suitable sizes for the thousand and one purposes for which the smaller pieces are required, and for which thinner saws such as Band Re-Saws and Deal Frames can be utilised.

Owing to the thickness of the circular saws which are the most suitable for the first process in converting logs in the forest, it is more economical not to attempt to convert the logs into sawn material of less than say 2" in thickness.

For work in the forest where the site of the mill has to be changed every year or so Log Band Mills and Frame Saws, not being of a sufficiently portable nature, are not to be recommended. Therefore the main machine should be a Rack Circular Saw Bench. A useful size for this is for saws up to say 54" diameter which would cut through the centre of a 22" diameter log or by removing preliminary slabs would be capable of converting logs up to about 30" diameter. Where the logs are not so large as this smaller machines can of course be employed, but it is always advisable to leave a margin in this connection, especially when dealing with hard timbers such as sal, etc., as the larger saws although they consume rather more power, cut much more freely. For logs larger than 30" diameter bigger machines can of course be supplied.

Opinions vary as to the best type of Timber Carriage for use with Forestry Rack Benches, and for general purposes I favour those of Steel Girder Framing fitted with adjustable dogs for gripping the wood. If, however, the plant is required for one purpose only such as producing sleepers, and provided that the trees are fairly straight and have not unduly large butts plain Steel Travelling Tables may be used, but these should be of a serviceable width say not less than 26" over all for a 54" machine.

With Indian labour the simpler the machine and the fewer parts there are to get out of order the better, and this especially applies to work in the jungle where repairs are difficult or impossible to carry out expeditiously. The plain steel tables are less expensive and, for simple requirements, easier to manipulate than those with Adjustable Dogs, but where the trees are crooked and consequently difficult to wedge, the Adjustable Dogs must be employed. For this reason Rack Benches with that type of timber carriage are shown in both the accompanying plans.

In cases where the first cost is not of primary importance and transport facilities permit, there should be as little timber

about the Rack Bench framing as possible, and none at all for choice. Machines with carriages built up on wooden frames are cheaper than the all-metal type, but whereas with the latter there is practically nothing to get out of order, the timber frames, which are usually made on the spot, and too often of insufficiently seasoned wood, are a constant source of trouble owing to the warping which is bound to occur under the constantly varying conditions of atmosphere and temperature in the East. When in India during the present year I was shown some appalling examples of this on machines, which I am glad to say were not of British manufacture.

Moreover, on the all-metal machines, which are of a much more solid nature, more accurate and quicker cutting can be obtained. They therefore fully warrant the slight extra cost.

If, on the other hand, circumstances such as those mentioned above preclude the adoption of all-metal machines, the timber from which the frames are to be made should be prepared, seasoned and treated with some preparation for keeping insects away, as long as possible before the metal work for the machines is delivered. This also applies to any wood used for the foundations of the machines.

The Feeds may be actuated either by means of wire rope or rack and pinion. Personally I prefer the former. A variable friction feed will be found extremely useful to enable the cutting speed to be increased or decreased while the saw is in cut. This, although not absolutely indispensable for jungle work, is very strongly to be recommended. I do not like feeds varied by slip motion, as they are not sufficiently positive in their action.

It is advisable to have machines with as few working parts before the floor level as possible to simplify foundations.

The rate of feed should be capable of variation from about 10 ft. up to 80 ft. per minute foot run to suit different timbers and depths of cut. Some people may consider this to be on the slow side, but in jungle sawing, where often only inexperienced labour is available, safety and accuracy should not be sacrificed to speed.

The feed should be driven from the saw spindle as this obviates the necessity of superfluous countershafting.

For those who cannot afford the price of a Rack Bench with Automatic Feed, a Hand Feed by means of a crank handle and pinion worked by a cooly standing in a shallow pit by the side of the machine is sometimes adopted, but this should only be used on smaller machines for light work, and the crank must have a sufficient throw to facilitate working.

The length of the timber carriage naturally depends on the maximum length of material to be sawn, and this should be kept as short as possible on account of transport. For all ordinary purposes a carriage for logs up to a length of 16 ft. and capable of extension by the addition of 8 ft. sections up to 24 or 32 ft. is sufficient. The handling of longer logs than this, especially with the larger trees, is often difficult, and for this reason it is better to have the trees crosscut to their approximate required lengths on the felling site.

For use with Breaking-down Rack Benches saw blades, from 42 in. diameter upwards, and sometimes even less, with inserted teeth will be found more satisfactory than the solid plate saws, as they maintain their diameter, are less likely to buckle and get out of order, and never require re-gulletting, but especially for cutting the harder woods care must be taken that the teeth are properly hardened, otherwise much time is lost in changing them. I have found in practice that saw makers do not always pay sufficient attention to this very essential feature.

For woods of a resinous nature such as *Pinus longifolia* *P. excelsa*, etc., solid plate saws are preferable owing to the resin clogging the joints of the inserted teeth.

A good stock of spare teeth and a few extra tooth holders should be kept for each saw blade, and the instructions for sharpening the teeth and keeping them in order carefully adhered to.

Inserted tooth saws, although more expensive than the plate saws to start with, should more than pay for the extra cost after a few months' running.

Two inserted tooth saws or four plate saws should be kept as a stand-by for each Rack Bench. These, with a set of exchange bearings for the saw spindle, a spare set of frictions, and a spare wire feed rope, are the only spares which, with reasonable care, should be necessary.

After the logs have been converted to suitable sizes on the Rack Bench the sawn pieces should be cut to the desired lengths by a *pendulum or other simple form of Crosscut Saw*, of say 30 in. diameter.

On leaving the Crosscut Saw the pieces should be cut to the desired sections either on a *Saw Bench* with a Hand Sliding Table, as shown in the illustrations, or on a Self-acting or Drag-Feed Saw Bench with a set of double rails and a timber carriage at either end of it. These machines should carry saws from 36 in. to 48 in. diameter, the former size being shown on the plans, but it must be remembered that the larger saws can often be used conveniently for breaking down small logs or branches, thus economising the time of the Rack Bench which can devote itself entirely to the heavier work. The choice and size of this machine would of course depend on the work required, but the saving in power by the smaller machines must also be borne in mind.

Personally I prefer the chain to the rope feed for these Self-acting Benches, but the Sliding Table machine is more suitable for Indian labour.

By removing the fence and fitting a false wooden table over the saw blade of either of these machines, just deep enough to clear the top of the saw *spindle pulleys, they can be used* to advantage for cross-cutting, and in that case it is as well to have a few saws with suitable cross-cutting teeth. The 30″ Pendulum Crosscut shown in Fig. I, *Plate* 9, *could thus be dispensed with*.

Where price is a consideration a Plain Saw Bench may be substituted for the Sliding Table or *Self-acting* machine, but this entails a considerable amount of hand labour in pushing hard and heavy pieces past the saw and is therefore not to be

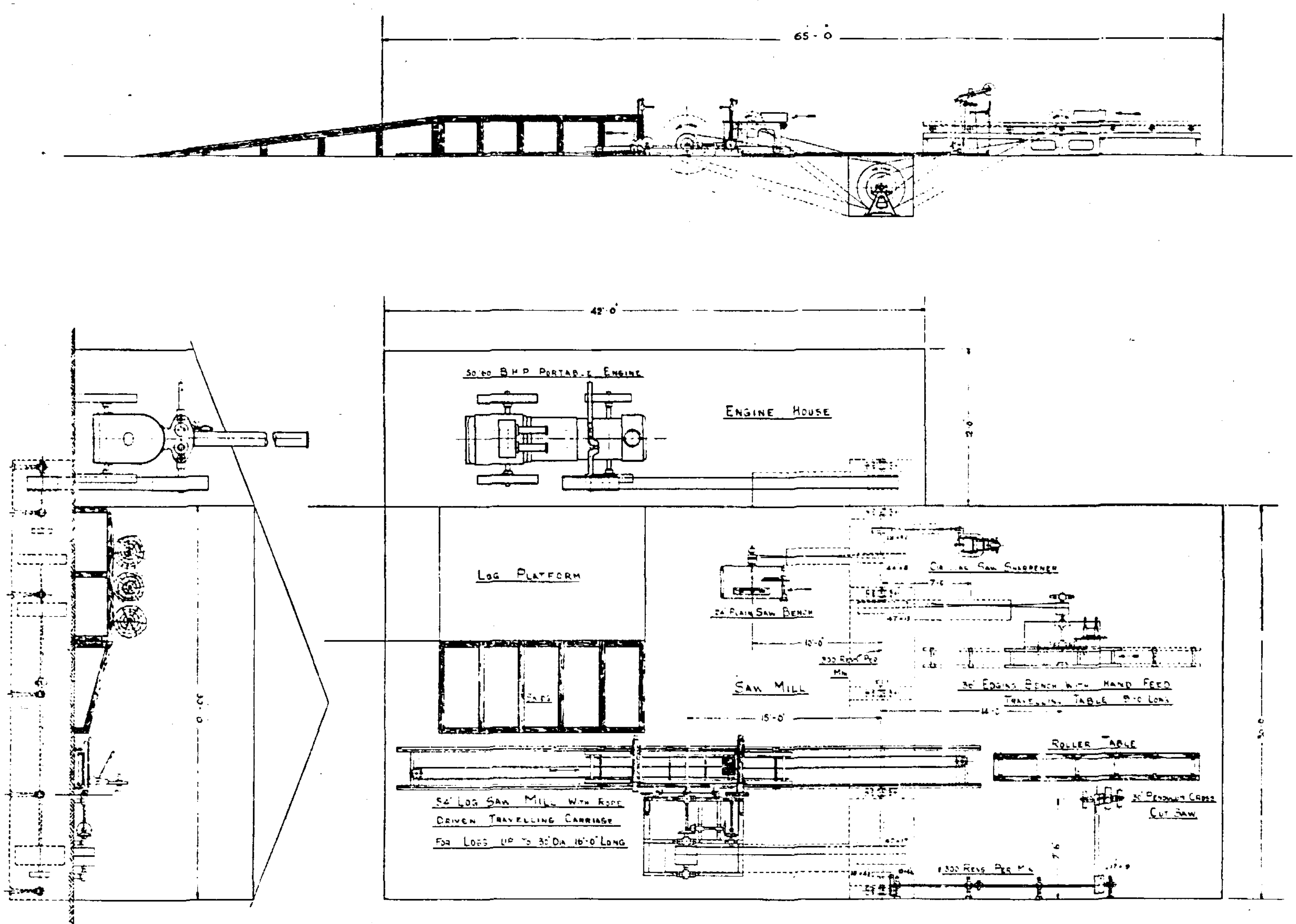

65-0
42-0
50/60 B.H.P. Portable Engine
Engine House
Log Platform
24" Plain Saw Bench
Saw Mill
15-0
10-0
36" Edging Bench with Hand Feed
Travelling Table 9-0 Long
Roller Table
54" Log Saw Mill with Rope
Driven Travelling Carriage
For Logs up to 30" Dia 16-0" Long
30" Pendulum Cross Cut Saw

FIG. I.

recommended. Whatever type of Saw Bench is employed horizontal rollers fixed at either end of the bench are a great convenience.

The spares for these machines should consist of 6 spare saw blades and a set of ball bearings for the saw spindle of each machine.

When the number of machines employed necessitates a line of shafting as in Fig. I, it often pays to have an additional small Plain Saw Bench for converting waste pieces, cutting up slabs for firewood, etc., etc., as it can be kept in constant use and leaves the larger bench free for more profitable work. A bench capable of carrying 18" or better still 24" saws would suffice.

Wherever possible, and especially when solid plate saws are used on the Rack Bench, it is best to have a simple type of Saw Sharpening Machine. This machine saves a great deal of time over hand sharpening and can be relied upon for sharpening teeth at the desired angle and well to the bottom of the teeth, the latter being seldom done when the saws are sharpened by hand.

With this machine two spare sets of centres for the emery wheel spindle and 6 spare emery discs should be kept.

Inserted tooth saws should be sharpened with a file, without removing the teeth from the saw. A three-cornered file should not be used as this tends to make a sharp corner in the tooth, but files specially supplied for the purpose should be employed. The face of the tooth must be filed sufficiently to get a keen edge to the full width. The back of the tooth must only be touched with the file so as to remove the burr. As the tooth is filed back the original shape of the hook must be retained.

The question of saw sharpening and treatment is an all important one, as no machines can work satisfactorily unless the saw blades are properly looked after. For this reason I would advise any mill owner to arrange to send whoever will have to sharpen his saws to someone conversant with this work to be initiated in the matter.

After considerable practical experience in Saw Mills with Indian labour I am convinced that the circular saw blades should be several gauges thicker than the standard thicknesses for blades of similar diameter in Europe, and a schedule is given below of the thicknesses recommended.

Gauges and kerfs recommended for circular saws of different diameters in the jungle :—

Diameter of saw.	Inserted Tooth Saws.		Solid Plate Saws.	
	B.W.G. on plate.	B.W.G. on tooth.	B.W.G. of plate.	B.W.G. of saw kerf.
18"	...	...	11	9
24"	...	...	10	8
30"	...	...	9	7
36"	...	...	8	6
42"	8	5	7	4
48"	7	3	7	4
54"	6	2	6	3
62"	5	1	5	2
72"	4	...	5	1

The above gauges apply more particularly to saws for hard and medium woods, but for soft woods they may be decreased.

It is essential, if the most is to be got out of any Saw Mill' that there shall always be a constant supply of logs ready for the Rack Bench, and in order to ensure this a log "deck" or platform should be arranged, as illustrated, from which a gentle incline made of wood serves for rolling the logs on to the timber carriage. A simple device for turning the logs is also of great assistance, or failing this a light pulley block arranged over the centre of the timber carriage on the feeding inside is often found very useful for this purpose.

It is assumed that the logs will be conveyed to the deck by bullock cart or similar means. If they are stored in water

near the Saw Mill some arrangement must be made for hauling them on to the deck.

For transporting the sawn pieces from the Rack Bench of Crosscut cut Saw to the smaller machine, a temporary overhead gantry supporting a pulley block or runway for pieces about a ton weight, depending on the sizes desired, will save an enormous amount of hand labour and materially increase the output of the mill. Failing this, wooden skids or a trough with rollers should be arranged from that Rack Bench or Crosscut to the next machine, and where the nature of the ground permits, it is an advantage to fix the latter machine at a lower level so that the sawn material can be more conveniently slid down to the table or timber carriage of this machine.

The foundations can be made of rough hewn baulks of timber mortised together, as it is not economical to put in brick or concrete foundations for portable mills of which the sites have to be frequently changed. The shafting pits can also be shored up with rough wooden slabs and the bearings for the shafting fixed on timber.

Although in both the accompanying plans the machines are shown fixed on the ground level, it is sometimes advisable to have the mill floor raised about 4 feet off the ground and the shafting fixed below it, but unless the mill is going to remain in the same place for some years before being removed to another site, this is not to be advocated on account of the extra expense involved.

For driving this plant a Portable Steam Engine of 50—60 brake horse-power should be used. The engine should be fitted with a specially large firebox for burning wood refuse and also have an injector as well as the feed pump.

If the nature of the country makes the transport of so large an engine difficult, then two engines of 25—30 brake horse-power each may be substituted for the single one.

The spares recommended with Portable Steam Engines for up-country work are –

1 set of crankshaft brasses.

1 set of connecting rod brasses.

1 set of piston rings.

1 pump plunger and joint.

1 set of firebars.

1 set of asbestos rings for man and mud holes.

6 gauge glasses and 12 India rubber washers.

3 tube brushes.

6 boiler tubes and twelve steel ferrules.

The question of lubrication is one to which sufficient attention has not always been paid. I should therefore advise the prospective millowner to consult with the makers of the machinery as to the best kinds of lubricant to be used. The makers are always very pleased to give this information and it often saves a great deal of trouble in the long run.

The choice of belting would depend to a certain extent on the part of the country in which it would be used, but a really good class of Balata belting with plate fasteners will generally be found suitable.

As outputs vary considerably according to the labour, the size and quality of timber and other reasons, it is difficult to specify any definite output. A Saw Mill such as described above, however, when working under average conditions, should be capable of dealing with 3,000 to 4,000 cubic feet of hardwood or 5,000 to 7,000 cubic feet of soft timber in a week of say 50 working hours.

About 17 Indians should suffice to run the mill, but this again would depend upon the physique and adaptability of the labour available.

The cost of such a mill complete would, at the present day, be in the neighbourhood of £1,400.

If the spares mentioned are taken with the outfit the annual upkeep should with reasonable care amount to very little.

The waste in circular saw cuts in jungle mills is naturally more than by the thinner hand saws, but this is so small in the class of sawing described in this article as not to merit consideration. The enormous increase in output and economy of time effected by good machinery as compared with hand labour should always be able to leave the old methods so far behind as to make

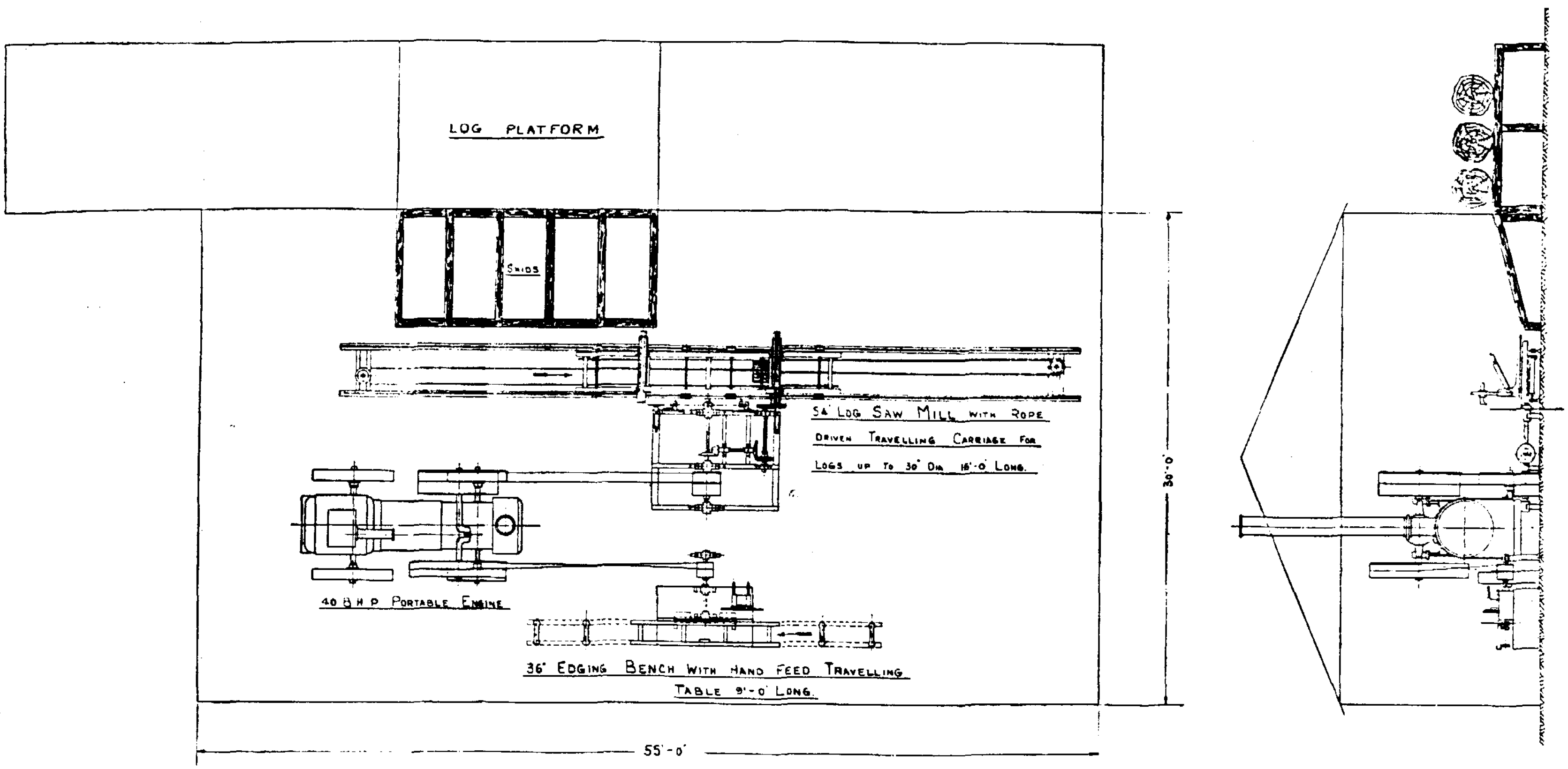

LOG PLATFORM
SKIDS
54" LOG SAW MILL WITH ROPE DRIVEN TRAVELLING CARRIAGE FOR LOGS UP TO 30" DIA 16'-0" LONG.
40 B.H.P PORTABLE ENGINE
36" EDGING BENCH WITH HAND FEED TRAVELLING TABLE 9'-0" LONG.
30'-0"
55'-0"

FIG. 2.

comparison futile, besides which hand sawyers in India are likely to become more and more expensive as time goes on.

For cases where the capital outlay involved by the mill shown in Fig. I is too great, or where the mill has to be moved from site to site every six months or so, another layout is shown in Fig. II, Plate 10. This smaller saw mill comprises two machines only, *viz.*, a 54" Rack Bench and a 36" Saw Bench with Sliding Table.

These machines are shown driven from a 40 brake-horse-power Portable Steam Engine with a flywheel on either side of it, and therefore no shafting whatever is required.

The cost of this mill would be about £900-0-0 and about 12 men would be required to work the machines and look after the engine.

In both plans the space occupied is clearly indicated.

Of course for temporary jungle mills elaborate buildings are out of the question, but care should always be taken to protect the machines from the weather, and such shelter as is necessary can be made of timber on the spot.

GEOFFREY RANSOME.

FROST AS A CAUSE OF UNSOUNDNESS IN *SAL*.

Mr. A. E. Osmaston's article with the above title in the October 1923 *Indian Forester* left the reader to draw various conclusions which, perhaps, as he said, would be none too comforting to those who had just completed working plans for divisions containing frost damaged *sal* crops.

Fortunately I had not completed my working plan so the above did not apply to me.

Mr. Osmaston's investigations demonstrated the fact that the exceptionally severe frosts of 1904-05, which cut back large numbers of *sal* in many forests throughout Northern India, have caused much unsoundness in young *sal* crops.

In the Ramnagar division (U. P.) this unsoundness in some of the best young *sal* crops is a very serious matter. I have examined all the young crops in the division, and have found

that in certain damaged crops, amounting to about 3,000 acres, practically every *sal* is more or less unsound.

The investigations were carried out on the following lines, according to Mr. Osmaston's practice.

Young and middle aged crops were examined, and trees were selected at more or less regular intervals over the areas, in order that trees in different localities and possibly under different conditions of growth might all be represented. In all 44 trees were selected, varying from 6½″ to 15″ in diameter, and 52′ to 101′ in height. 42 of these trees were dominating, and most of these were what are called "pre-dominant" trees. They were the very best trees in the crops, and were chosen not because they might be unsound, but because they were apparently sound, and undoubtedly the healthiest trees in the crop. Every effort was made to try to find sound trees but out of the 44 selected only one was quite sound. This was indubitably an exceptional tree in a less badly damaged condition than the rest.

On almost all the trees in the crops there is a distinct frost mark, where the tree was cut off by frost, and from which the new shoot started. About 80 per cent. of the trees examined had single leaders, and these leaders were always quite sound and unaffected by the frost.

The selected trees were felled, and cuts were made at frequent intervals in the stem to trace the extent of the rot. The rot invariably started at the frost mark and extended downwards towards the base. The attack was most severe at the frost mark and decreased lower down. At the point of attack the centre of the stem was sometimes hollow and filled with liquid but more often soft, pulpy and dark coloured. The rot takes the form of a cone with its base at the frost mark and its apex pointing towards the base of the tree. Towards the apex of this cone the wood becomes harder and lighter coloured and the rot eventually merges into quite normal wood. Thus it seems evident that the rot is progressing down the stem from the frost mark. In cases of doubt, when possibly discoloration might be due merely to a dead branch, the stem was split open longitudinally to trace the origin of the rot. All the trees

examined were *sal*, though a *bakli* (*Anogeissus latifolia*) accidently felled was also affected by rot.

Results—44 trees were felled: 43 were affected by rot: 1 was unaffected.

Average diameter—10·1 inches.

Average extent of rot—10 feet 2 inches.

Note—Some trees were *rotten right down to the base*, but if there was any doubt about the basal rot being due to some other cause they were left out of the calculations.

Conclusions.—(1) Rot as the direct result of the frost damage has seriously affected practically all *sal* in these areas.

(2) The rot progresses down from the point of frost damage towards the base of the tree at the average rate of 7 inches per year.

(3) A large part of the best young crops in the division are damaged seriously, and in view of the fact that the damage increases yearly, it is evident that by the time these crops are mature they will be practically useless for the production of valuable timber.

(4) Such badly damaged crops should be removed as soon as possible.

As a result of this investigation some 3,000 acres of young or middle aged *sal* crops in this division are being allotted to the regeneration period in place of mature crops, with a consequent reduction in yield.

Though these results are proved to be correct for only one division, it stands to reason that there is every possibility that the same unsoundness will necessitate the same readjustment of allotments elsewhere in Northern India.

An attempt was made to follow up Mr. Osmaston's idea that possibly the position of the visible scar in the form of an occluded channel might be correlated with the points of the compass. It was found, however, that the aspects of these scars were exceedingly variable, and in one especially noticeable case the scars on three trees all growing close together were facing in three

different directions. It seems, therefore, that the position of the scar has nothing to do with the aspect.

Mr. Osmaston states that in his examination of trees the stems were split open longitudinally, but I found this to be impossible in the case of the biggest trees.

One bright aspect of the question of frost damage in this division is that the regeneration of the damaged areas will probably not be difficult. The crops are well stocked and often of I to II quality; chiefly poles and saplings but with a number of larger trees. They will be regenerated by retaining a certain number of well-spaced trees in the overwood and by cutting back the rest of the crop all at once. Dense coppice regeneration is expected and a good deal of seedling regeneration from the standards in the overwood.

The possibility of the recurrence of such exceptional frosts must be faced, and it may possibly be found necessary in the future to work such areas as coppice, with the length of the rotation depending on the frequency of exceptional frosts.

However, there is no need to be pessimistic about this, as perhaps by that time, coppice crops will be readily saleable owing to the wholesale removal of large trees by our successors.

G. M. HOPKINS, I.F.S.

DUGOUTS OF CHITTAGONG.

Being locally used in large numbers and also exported to other riparian districts of Bengal, dugouts play an important part in the exploitation of our timber resources in the Chittagong Hill Tracts, and the annual outturn of them is thus a matter of considerable interest in the Forest Divisions* of Chittagong from a revenue as well as an economic point of view.

Presumably from an economic standpoint the conversion of trees into dugouts is wasteful exploitation of timber, and may

*1. Chittagong (Sudder) Division.
2. Chittagong Hill Tracts Division.
3. Cox's Bazar Division.

well be denounced, but in localities like Chittagong where the internal communication in all seasons through narrow, shallow, hill rivers and creeks—incapable of harbouring heavy boats—is an absolute necessity to the community, it cannot altogether be dispensed with. It is sometimes, on the other hand, supported by saying that only overmature trees—too far in the interior wilds to be extracted in logs—are converted into dugouts. The main reason is that the hillmen of Chittagong are not accustomed to the work of sawing and they do not like it, having inherited from their ancestors the habits of working with the simplest tools such as axe, adze, etc., easily available in the local market. They even make planks out of logs by axe only. Moreover, the making of a dugout from a tree is comparately a lucrative business, being finished with less labour and time than what is required for conversion and extraction of the same tree in the form of scantlings.

On account of the waste of timber the making of dugouts is prohibited in the Reserved Forests and is confined to the unclassed open areas of the Chittagong Hill Tracts. The average annual outturn of dugouts from these open areas is approximately 1,500 in number and 1,54,000 cubic feet in volume, and the average annual revenue derived is about Rs. 13,000. Of this annual outturn 50 per cent. is exported to other plains district of Bengal, where dugouts could well be dispensed with and replaced by boats made of sawn timber, with the effect of saving a large volume of utilisable timber. In certain areas of the Chittagong Hill Tracts such as the Bakhali Valley in the Cox's Bazar Division—where the annual outturn amounts to 700 in number and 53,000 cubic feet in volume—the use of standing stock for dugouts has brought about conspicuous scarcity of trees for extraction in scantlings, and in such areas restrictions in the near future may be necessary.

Apart from economic considerations it may interest our readers to know how the trees are transformed into these floating craft. It is generally known that they are made by hollowing out the trunk of trees but the actual process shows the indigenous ingenuity of our hillmen and deserves notice.

Amongst the hill tribes of Chittagong, Mughs and Chakmas are specially expert in this particular work of making dugouts. Years ago when the sources of supply were not impoverished by heavy *jhuming* (shifting cultivation) and excessive fellings, only the good species—*jarul* (*Lagerstrœmia Flos-Reginae*), *telsu* (*Drimycarpus racemosus*), *chapalish* (*Artocarpus Chaplasha*), *kamdeb* (*Calophyllum polyanthum*), *boilam* or *boilsur* (*Swintonia Schwenckii*), *champa* (*Michelia Champaca*) were used, but now, suitable trees of any species are being converted into dugouts *boilam* or *boilsur* (*Swintonia Schwenckii*) and *garjan* (*Diptero-carpus turbinatus*) being trees of long clean boles are usually selected for big dugouts.

In selecting a tree for a dugout attention is paid to the following points:—

(*a*) The bole of the tree must be cylindrical and of sufficient thickness.

(*b*) The portion of the bole to be taken must be free of knots and any rotten side-branch and it must not be crooked or swollen.

The local people have their own units of measurement for the ength and breadth of a boat. These are called *bios* and *paws*, respectively. A *bio* used in measuring the length is equal to the space between the tips of the middle fingers of a man's hands stretched horizontally or about 5 feet 6 inches. A *paw* is the length of a man's foot—or about nine inches.

The number of *paws* is not the horizontal space between the two edges of a boat, but the inside circumference. A boat should have at least as many *paws* in breadth as it has *bios* in length and may have more. A dugout having more *paws* than the number of *bios* will have more carrying capacity and will sell at a higher price than the one with the same or less *paws* than the *bios*. In selecting, therefore, a tree for marking a dugout, suitable breadth with reference to the length obtainable from it, is the first and foremost consideration of the hillmen. When a hillman finds a tree suitable in outward appearance for conversion into a dugout, he sets out to ascertain the number of *paws* obtainable from it. There are two ways in which the *paws* are ascertained

from a standing tree. The first one is adopted by the most experienced men only. Standing at a distance equal to the supposed length of the tree from its base—he holds up one of his fingers at a space of twelve to fifteen inches from one eye, and, shutting the other, compares the thickness of the middle of the bole with that of his fingers. Each of the five fingers has its known *paws* thus :—

Thumb finger represents ...	...	8 *paws*.
Middle finger ,,	...	... 7 ,,
Fore and Ring ,,	...	... 5-6 ,,
Little finger ,,	...	... 4 ,,

A boat of less than four *paws* is not usually cut. The second method is very ordinary and is usually adopted by hillmen before felling a tree for a dugout. A string or flexible climber is tied to the top of a bamboo long enough to reach the middle of the bole, and is lifted by one man, while a second bamboo of the same length with fork or hole at the end to receive the string is pushed round the tree by another man at the same level. A knot is tied by rolling the second bamboo and both the bamboos are then brought down slowly to the ground. The mid-girth thus obtained on the string between the two bamboos is measured off by *paws*. The approximate breadth in *paws* obtainable from the tree will usually be two-thirds of the number of *paws* measured on the string. In other words one-third is the standard allowance for space, sapwood and dressing, but this is subject to variations according as the species has thick or thin sapwood. For instance, *telsur* (*Drimycarpus racemosus*) having thin sapwood has one-fourth as allowance, whereas, *chapalish* (*Artocarpus Chaplasha*) with thick sapwood has one-third or standard allowance.

A tree, especially, a large and old one, is not felled by the hill men until some strange customs and observances have been gone through to propitiate the tree-spirit which they so strongly believe in. They carry the axes to be used in the felling to the tree on the previous day and after making offerings of cooked rice and sacrifices of fowls, pigeons, eggs, etc., leave the axes near the offerings and sacrifices under the tree. If the offerings appear on the next day undisturbed just as they were left, the tree is

3

felled, if the offerings are thrown in disorder the tree-spirit or the God of the Wilds is angry, and they believe that to fell the tree will entail severe punishment to the fellers. These peculiar ceremonies may be compared with those described in an article at page 578 of November 1922 number of the *Indian Forester* by Dr. Howe. The felling is done by axe only and is finished in one day for fear of the trees being blown down, which might cause shakes in the log.

After felling, the maximum breadth in *paws* is finally ascertained by measuring and the middle point marked off. From this point the same number of *bios* are measured in each direction and the bole cut to its final length. Before the actual hollowing begins the entire body of the log is thoroughly examined for any defect which might appear on the hull or bottom of the boat and thus interfere with its value. Such a defect as for instance one caused by fungi, the scar of a rotten side branch, a knot or the trace of an insect attack—if discovered—is avoided as far as possible by including it in the space for holding out the cavity. This space is faced upward by rolling the log on poles placed at right angles underneath. This is easily done even in the case of logs 50 feet to 60 feet in length. The upper surface is then blazed by adze nearly to the heartwood. The diameter of the log is measured by holding a stick horizontally between two others put up tangentially at edges of the log and a space with breadth equal to one-third of the diameter is marked out on the blazed surface,—leaving short spaces at both ends for stem and stern which vary according to the size of the boat roughly thus :—

For boat 8 *bios* and upwards		... 3′—4′
" " 6 & 7 " ...	...	... 2′—2½′
" " 4 & 5 " ...	...	... 1½′—2′

The hollowing is then done keeping strictly within this space to the depth of about three-fourths of the diameter of the log.

The hillman uses a peculiar tool for the hollowing which deserves notice. It is an axe and adze combined so that one

and the same tool serves as both—only it being turned and fixed in the same shaft in the required shape to suit the work. The shaft has a thick oval head with a square hole through it to receive the tool.

As the hollowing proceeds the hillman examines the depth of the cavity in order that he may not exceed the standard depth of three-fourths of the diameter and this he does by means of his fists, over a stick. The depth according to measure of the fists, will be 3 fists for a boat of 4 *paws*, 4 fists for one of 5 *paws* and so on. This, on calculation, has been found nearly correct to the standard depth of three-fourths of the diameter. Thus, unlike our carpenters, the hillman uses no artificial measures for his work, but uses one or other of his limbs instead. It is likewise desirable for a Forest Officer to be able to work out his problems in the jungles without artificial instruments.

The first stage of the hollowing out of the cavity having been finished as indicated above, the stem and stern of the boat are roughly shaped—the former being kept towards what was the top of the tree. The log is then turned over and the outer surface is dressed up to the heartwood and finished to the shape of the boat—the stern being so cut as to raise its level above that of the stem. In dressing the outer surface, a peculiar implement—a crooked chisel with a long handle—is used as a jumper. The log has now the appearance of a finished dugout—there remains only a mass of wood inside to be cut away.

In order to ensure a uniform thickness in the hull, which is important, guiding bores equal to the requisite thickness are made 20 inches apart in horizontal lines, 6″ to 9″ apart all over the outer surface. These bores are made by ordinary augers and are $\frac{1}{2}$″ to $\frac{3}{4}$″ diameter. The augers used sometimes have graduated points marked on them for each size of boat.

Boat of 4 *paws*	...	... 1 inch thick.
,, ,, 5 ,,	...	... $1\frac{1}{4}$,, ,,
,, ,, 6 & 7 ,,	...	... $1\frac{1}{2}$ in. to 2 ins.
8 ,, and over		... $2\frac{1}{2}$ ins. to 3 ins.

The boat is then turned over again in order to finish the hollowing out. This time the workman must be careful not to go beyond the level of the guiding bores. He digs down cautiously to one of the bores and proceeds to excavate from that bore to another until all the bores are exposed and the intervening spaces clean planed.

For this work he uses a tool with a short handle and comparatively more time is required to finish this stage

The interior being finished the boat is again turned over and the bores are plugged from outside. A very strong climber, probably *Ichnocarpus frutescens*, which does not grow more than $1\frac{1}{2}''$ in diameter is found plentifully in the Hill Tracts. The Hillman calls it *shamalata—shama* meaning "to close" or "to press." The stem is tough and has tuberous fibres so that it sucks and swells in water and lasts almost as long as a boat. This climber is used in closing up the bores. The stem is cut into short pieces 4" to 6" and being barked off and made slanting to one end to go into the bore are driven tightly in as corks and any extra portion remaining outside is cut off to the level of the surface.

The dugout is now only a hollowed log with a narrow opening of one-third of its diameter and, in this state if floated in water, it will roll over—so it requires to be expanded in breadth. In order to expand it, it is steamed by fire being kindled all along underneath with the slabs and chips of the hollowing and dressing. The fire is kept uniform without strong flames to overheat any part—the boat being raised on thicker blocks of wood this time. The wood of the boat being green and sappy—the effect of the steaming is that the whole body of the boat becomes quite soft and expansion is easy. While steaming the hillman strikes the boat with his axe, and by the sound he knows when the boat is ready. The fire underneath is then removed, and before the warmth subsides, the boat is turned quickly right way up, stretched with forked pieces of wood kept in readiness for the purpose. These forked pieces are hooked on the gunwhale at equal distances roughly 3 ft. apart, their upper ends being tied tightly with string or climber to pegs driven in the

ground on either side of the boat. Gradual strain being applied through the forked pieces equally on both sides, the boat expands to the required breadth and is then allowed to cool down for one night.

In order to keep the breadth after the boat cools down, temporary thwarts ot tough wood are put in before the forks and the strings are taken oft. In case of big dugouts the temporary thwarts are not sufficient and in addition short wooden knees are fitted inside the boat and tied down by strong canes through bores made for the purpose. The dugout is then ready for removal to the market.

Various contrivances are often employed by the hillmen for extraction of dugouts from difficult places over ridges, and slopes and they are sometimes very interesting but it is not intended to enter into details about them in this article. Extraction of small dugouts 4 to 6 *bios* in length is done easily by three or four men by putting poles and saplings underneath. A hole is made at either end of all boats for tying a rope or climber to. Big boats are extracted similarly, the additional labour to move them being arranged by mutual exchange amongst parties of the hillmen—the party engaging the labour giving a feast to the labourers after the extraction. The dugouts are thus dragged to the nearest stream by the shortest route, big boats at a considerable distance from the running water being left until the rains.

The dugout in this condition is marketted by the hillmen but it has to be finished and further expanded before it can be used. There are some ordinary carpenters who do this job after the sale of the dugout. The temporary thwarts are removed and permanent wooden crooks fitted round the inside in their place. The removal of the temporary support after 2 or 3 days of the dugout being in water does not affect the breadth so as to render the boat liable to rolling. These supports, it is curious to notice, are often removed on the way when the boat is about to reach the Toll Station for payment of royalty in order to reduce the girth by some inches.

After taking down the dugout on payment of royalty the owner employs the carpenter for fashioning it. The dugout is

drawn ashore and raised on blocks of wood or pieces of plantain trees. Any planing or polishing that may appear necessary in the inside and the stem and stern is done. A thin layer of clay mixed with cowdung is then applied to the outside surface which is moderately steamed by fire for easy expansion. Crooks or knees of several sizes cut out of crooked branches, buttressed bases or thick angular roots of trees are fashioned and kept ready, so that as soon as the dugout has been steamed and stretched again by means of forked pieces of wood as before, these crooks are fitted on the inside to keep the expansion permanent. These crooks are tied down tightly to the body of the boat through bores by *bhudum* canes (*Calamus Flagellum*) and the planing and polishing of the outside is finished. Being then oiled with earth oil all over inside and outside--the boat is fit for use. There is another category of dugout specially designed by the hillmen in the Karnafully Valley of the Chittagong Hill Tracts for export to the district of Noakhali, Bengal, where only they are usually found to be used in the extensive *bils* (fields inundated with water) and shallow rivers there. The process of their manufacture is almost entirely different from that employed for the ordinary Chittagong dugouts—the subject-matter of this article. These specially designed dugouts are exact transformations of the log without being expanded or bored in the body. An attempt will be made to describe the process of their manufacture on a subsequent occasion.

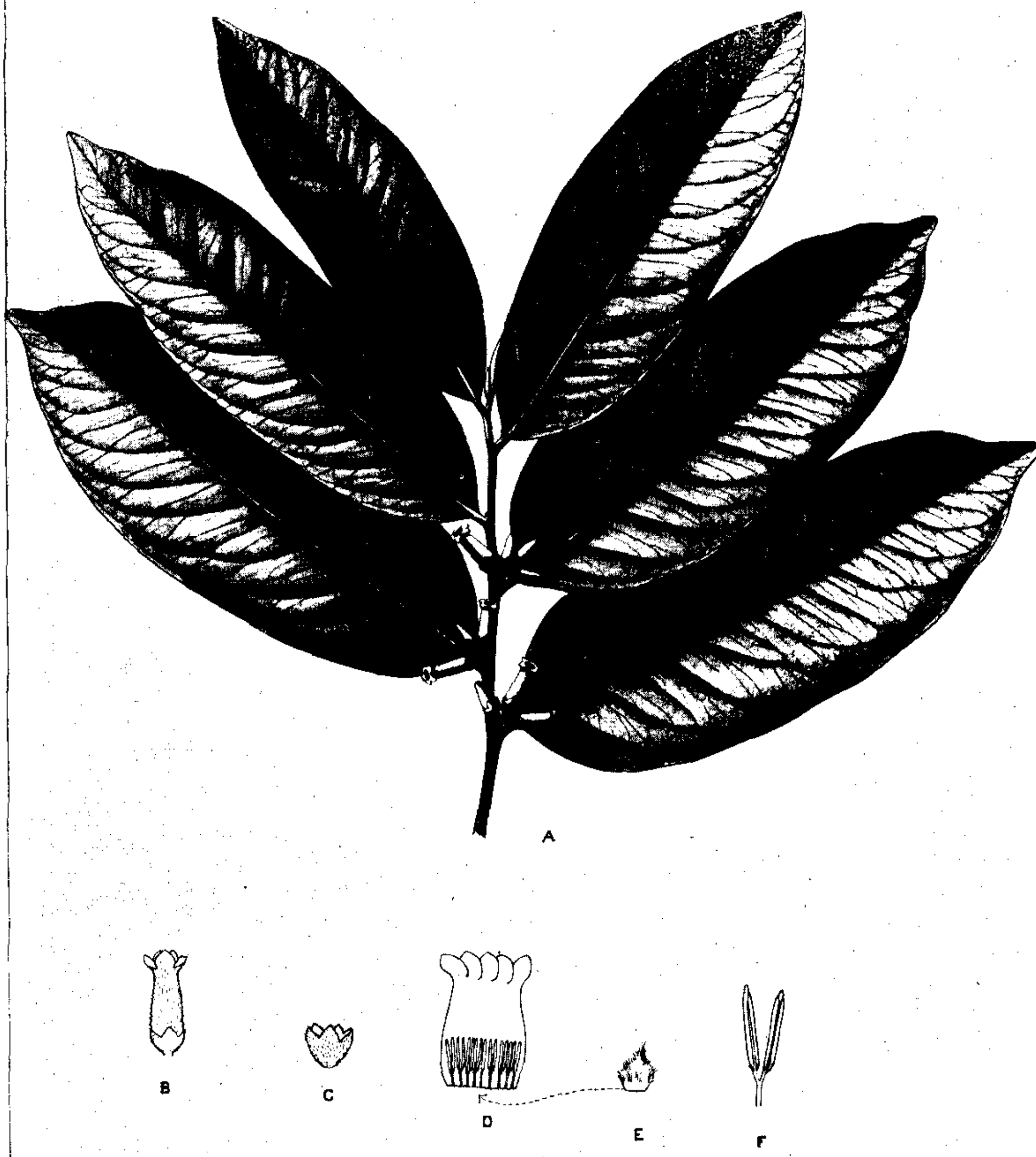
The writer is greatly indebted to Mr. E. O. Shebbeare, I.F.S. and also to Mr. J. N. Bose, P.F.S., Bengal, for some corrections and improvements in the article.

COX'S BAZAR DIVISION, *BENGAL.*

SATISH CHANDRA GUHA, *Deputy Ranger.*

A NEW SPECIES OF *DIOSPYROS*.

In October 1919 specimens of a *Diospyros* were sent from Gonda Division, U. P., which exactly matched a sheet of Duthie Inayet No. 23709 from Jalesani, Nepal in Herb. Dehra). This latter sheet had male flowers only and had been included



GANGA SINGH, *del.*

DIOSPYROS HOLEANA, GUPTA & KANJILAL—SP. NOV. ♂

amongst *D. Embryopteris* sheets. Examination of flowers however showed that it was not *D. Embryopteris* and that it probably belonged to a new species allied to *D. Embryopteris*, Pers. Specimens were accordingly sent to Kew for comparison but they could not be matched there with any specimens. Subsequently fruiting specimens were collected from the same place which at once showed that the plant in question was quite distinct from *D. Embryopteris*.

We have great pleasure in naming the plant after Mr. R. S. Hole, C.I.E., of the Indian Forest Service, in remembrance of his great services to Indian Botany.

Diospyros Holeana, Gupta and Kanjilal, sp. nov.

Arbor; remis novellis minute tomentosis, adultis geabris; cortis extra cinereo-nigro, intus rubro. Folia alterna, elliptica vel oblongo-elliptica, apice acuminata, basi cuneata vel obtusa 6·5-19 cm. longa, 3-6 cm. lata, coriacea, glabra, margine integra, nervis utrinque distinctis: petioli 4-7 mm. longi. Flores masculi 3-4 fasciculati, sub-sessiles, pedunculi 2-2·8 mm. longi, ferrugineo-tomentosi. Calyx pubescens, brevis, cupuliformis 4·3 mm. longus, 4-5-fidus; dentes breves, ciliolati. Corollæ tubus 1·2 cm. longus, extra appresse pubescens, intus glaber; lobi 4-5, 2·2 mm. longi; antheræ geminæ, 16, lineariæ, minute pubescentes, connectivo apiculato. *Ovarium rudimentaceum. Flores feminei* in foliorum axillis, solitarii, subsessiles; calyx late crateriformis, 1·1 cm. longus, lobi 4-5, late ovati vel rotundati, appresse tomentosi, basi sub-auriculiformis. Corollæ tubus 1·4 cm. longus, pubescens, lobi 4-5, 6 mm. longi; staminodia 11, apice crassa. Ovarium *tomentosum, 6-loculare, loculis 1-ovulatis, styli 3* Fructus rotundatus, 3 cm. diametro, glaber.

Nepal border; Sungarah forest (P. C. Kanjilal Nos 2440, 2441 and 2441*a*); Jalesani, Inayet No. 23709 (29-4-1900) in Herb. Dehra.

It is a medium sized tree with straight trunk. Bark dark grey, rough on the outer surface, shallowly fissured, exfoliating in small plates. When freshly cut it is dark red inside.

Wood greyish brown with darker concentric bands, close grained with no heart wood; pores scanty, radially arranged in short groups; medullary rays numerous, fine; transverse bars visible in a thin section.

This species is allied to *D. Embryopteris*, Pers. differing from it however in the following points:—

(1) Rougher bark exfoliating in small plates.

(2) Venation of the leaves being much less raised on both surfaces.

(3) More densely silky tomentose flowers.

(4) Fewer stamens.

(5) Fewer-celled ovary.

(6) Glabrous fruit.

The albumen in the seed in both species is non-ruminated.

Our sincere thanks are due to Mr. R. N. Parker, I.F.S., Forest Botanist, for much valuable help and encouragement in the matter.

B. L. GUPTA,
Assistant to the Forest Botanist
and
P. C. KANJILAL, I.F.S.

EXPLANATION OF PLATES.

PLATE II.

Diospyros Holeana, Gupta and Kanjilal, sp. nov.

A.—Part of plant, ♂

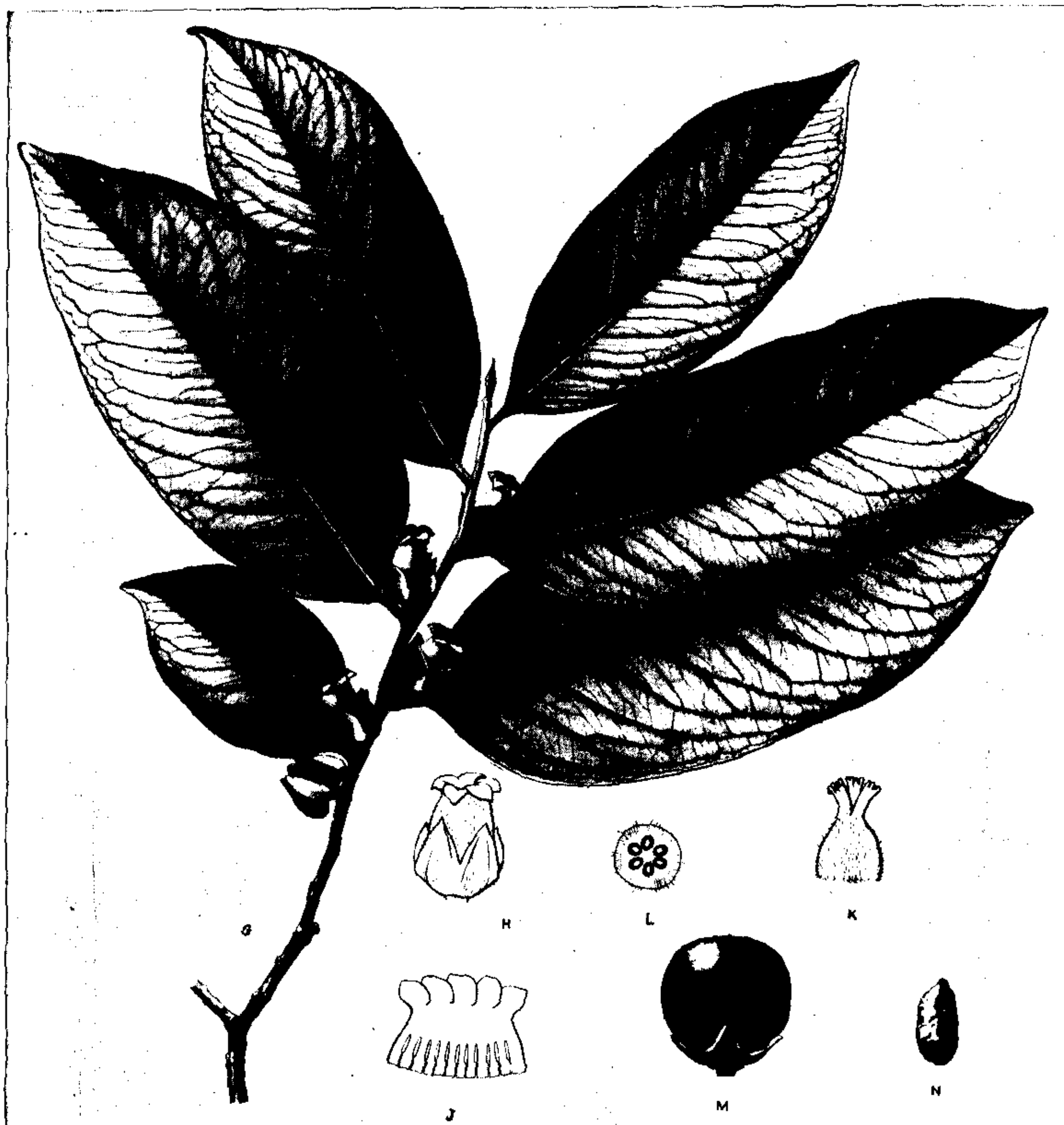
B.—Flower.

C.—Calyx.

D.—Corolla with stamens.

E.—Pistillode.

F.—Stamen.



GANGA SINGH, *del.* DIOSPYROS HOLEANA, GUPTA & KANJILAL. SP. NOV. ♀

PLATE 12.

Diospyros Holeana, Gupta and Kanjilal sp. nov.

G.—Part of plant. ♀.

H.—Flower.

J.—Corolla with staminodes.

K.—Ovary.

L.—Transverse section of ovary.

M.—Fruit.

N.—Seed.

ELEPHANT CAPTURING WITHOUT DECOY ELEPHANTS IN THE GANDAMANAYAKANUR ZEMINDARY, MADURA DISTRICT, MADRAS.

Ages and ages ago, from the days of the forgotten past, this sagacious animal is known in India. And the methods of capturing and training them remain hardly changed for the last 2,000 years or more. In the hymns of the *Rigveda*, the elephant is known as the animal with divine qualities. In the *Atharvan*, he is the mightiest monarch of the animal kingdom. In the Puranas, he is the Hindu god *Ganesha*—a mighty god to be worshipped for the success of any mighty task undertaken. In the Epics, the elephant is the leader of the warfare. Even in the Buddhist period, the elephant is spoken of by Monier Williams as the most sacred of animals. But, no useful historic record of these times about the methods of capturing and taming these animals, is available, till the European writers—Megasthenes 300 B.C., and Strabo 25 B.C.,—give full particulars regarding the manner of hunting and capturing the elephant.

After these writers, we remain in obscurity and when centuries had gone by, we see the Indian elephant again, coming into prominence, when the kingdom of Vijayanagar was rising to the noon-time of her glory. Then Baber, the greatest historian Mogul emperor of those days, in his Memoirs, 1525 A.D., gives graphic details regarding Indian elephants,—their several species, their use in warfare, and the domestication to which they were subjected, and Sanderson, in his "Thirteen years among

the wild beasts of India" describes the methods of elephant capturing then prevalent. Subsequently, many other writers and Forest Officers have contributed valuable information to the stock of the present day knowledge. But, from the ancient classic times down to the present day and date, there is no instance of any historic record of elephants being captured in the pit system without the assistance of any decoy elephants at all.

Now in the Gandamanayakanur Zemindary, in the District of Madura, after several centuries have elapsed, a profitable change has been newly introduced in the method of elephant capturing by the pit-system. The maintenance, or the hire, or the use of decoy elephants has been completely done away with. The scheme was started on the zemindary some 4 months back by Mr. Pestonji D. Patel of Bombay who is the sole Proprietor of the Zemindary. And already six elephants have been captured and are safely enkraaled without any assistance at all of decoy elephants. The elephants captured are ranging from 12 months to 25 years of age.

In this Zemindary, in suitable sites selected for the purpose, the elephant pits are dug as single pits instead of in groups of three, so that on all the four sides of this single pit, the ground is suitable for any construction. The kraal materials are so made as to be easily transportable in parts and readily fitable over the pit in which the elephant has fallen. The bottom of the pit is gradually raised by throwing in mud, and the capture comes step by step, up into the kraal, that is fitted over the pit in the mean-while. After the elephant is got up and tamed in the said kraal, which is called *kuli bandhi*, the kraal materials are removed to be used in a similar way for any other capture. Thus, this new system completely saves the trouble, the expense, and the risk, of marching a wild elephant to the kraal with decoy elephants. Under this system, instead of the captured elephant being taken to the kraal, a kraal of a transportable size goes to the elephant that has fallen into the pit. Instead of the mountain going to Muhamad, Muhamad has gone to the mountain quite easily ! !

Thus, so wisely, so easily, and so cheaply, the proprietor of this Zemindary, in addition to his commercial enterprise in elephant capturing and selling, has rendered the many thousands of acres adjacent to the forest easily cultivable without any fear of devastation by these wild animals. The scheme is so cheap and feasible that it can be undertaken even by smaller forest owners and the Forest Department, if they would like to benefit themselves and benefit the public by bringinglarger areas under cultivation.

A FOREST INSPECTOR.

SILVICULTURAL NOTES.

The following Silvicultural experiments have recently been initiated in Bihar and Orissa :—

(1) Two plots have been laid out in damper types of sal forest with the object of testing the effect of continuous fire protection on the regeneration of sal and other species found within the plot.

The method of carrying out the experiment was to effect a detailed enumeration of all species at present in the plot. Further enumerations will be carried out at intervals of 5 years.

(2) Three plots have been laid out in pole, middle aged and mature sal forest respectively characterised by optimum conditions for natural regeneration with the object of ascertaining how long it takes for regeneration to establish itself.

The method of procedure was to clear the underwood and uproot all existing seedlings.

(3) One plot has been laid out in sal forest of optimum type with the object of testing the effect of annual fires on the establishment of natural regeneration therein.

The procedure was the same as under (1) above.

(4) Two plots have been laid out in bamboo *(Dendrocalamus strictus)* forest with the object of testing the effect of the system of working prescribed in the 1921 Sambalpur Working Plan, *i.e.*, a three year rotation leaving all culms under 18 months age in addition to 6 older culms.

The procedure was to subdivide each plot into 2, one-half being worked according to the Sambalpur prescriptions, and the other half left unworked as a Control plot.

(5) Five plots have been laid out to test the coppicing powers of various species under rotations of 20, 40, 60, 80, and 100 years respectively, and the possibility of securing without special measures sufficient natural regeneration to secure the perpetuity of the forest under a system of working of simple coppice.

The method of carrying out the experiment was to coppice all species over 2" in diameter and uproot everything under 2" in diameter. The age, diameter, and height of trees felled was recorded. A complete record will be maintained for each stool of the size and volume of all shoots produced under each successive rotation whether removed in thinnings or in final fellings natural regeneration establishing itself during each rotation will be coppiced after it attains a diameter at breast height of 2".

(6) Two plots have been laid out in poorly and well stocked sal forest respectively to test the effect of the system of strip fellings prescribed in the 1921 Sambalpur Working Plan on the establishment of sal regeneration.

The procedure was to fell a strip in accordance with the working plan prescriptions, and to cut back the established

regeneration thereon after carrying out a detailed enumeration of all established regeneration. A height of $1\frac{3}{4}$ feet being arbitrarily chosen as the minimum height of an established seedling of any species. Further enumerations will be carried out at intervals of 5 years, successive strips in the cutting series being felled in accordance with the provisions of the plan, and similarly enumerated.

Further experiments on the above lines will be initiated shortly. In the case of the fire experiments it is particularly necessary to ascertain the effect of fire on regeneration in all types of sal forest, *e.g.*, it is almost certain that fire protection is inimical to the regeneration of damper types of sal forest but as such types are very limited in area, such knowledge is of little practical use, unless one can prove that the withdrawal of fire protective measures from the more extensive areas of drier sal forest surrounding the damper forest will do no harm.

J. W. NICHOLSON, I.F.S.,
Provincial Research Officer,
Bihar and Orissa.

WORKING COSTS IN SMALL POWER PLANTS.

BY T. E. LOVE, M.I.E. (IND.).

Industrial civilisation has for its foundation cheap power, all power is developed from heat energy stored either in coal, wood, oil or water with potential energy. India in the transformation from a purely agricultural country to, in part, an industrial

country has need of small power plants between 25 and 200 H. P., especially those between 50 and 100.

The choice really lies between (*a*) burning coal or wood under a boiler to produce steam for a Steam Engine; (*b*) burning wood or charcoal in a gas producer to make gas for a Gas Engine or (*c*) using oil fuel in an Oil Engine. Water power is not considered as it is only available in specially suitable sites.

All three types of prime movers, Steam, Gas and Oil have certain limitations depending on their prime cost rate of depreciation, reliability against break-down, cost of fuel and running charges and these limitations have to be considered before deciding on any particular type of power plant.

With the present developments of internal combustion engineering it may be taken that Gas and Oil Engines with good supervision are just as reliable as Steam Engines. There are, of course, certain obvious limits for each type of power plant thus: Kerosene Oil Engines and Gas Engines using charcoal as fuel would only be used in the smaller sizes of power plants. Gas Engines using wood fuel should not be supplied for powers below 30 to 40 H. P. Diesel Engines also hardly come within the scope of this paper as their place is taken by the Cold Starting Solid Injection Oil Engine. Steam Engines in their various types are built for the whole range of power, but it is only in the very largest sizes that their thermal efficiency anywhere equals that of the Internal Combustion Engine.

The working costs can be divided under two heads:

(*a*) Capital charges which include depreciation and interest on Capital expenditure.

(*b*) Running charges which include cost of fuel, lubricating oil, water-supply, labour and stores and repairs.

CAPITAL CHARGES.

In the capital cost chart, appended to this paper, the following have been included with each type of plant:—

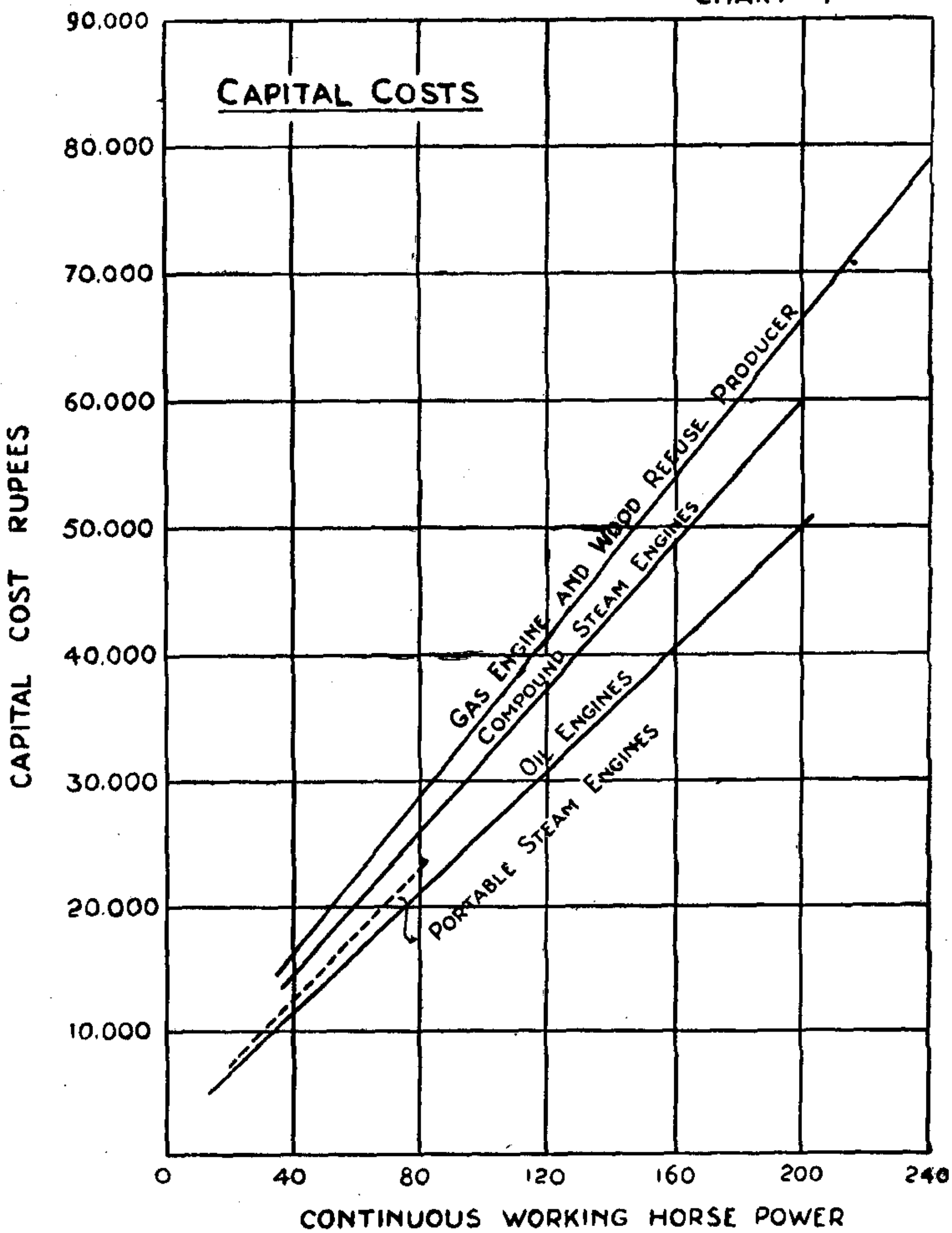
Steam Engines are complete with boiler, feed pump or injector, all piping, foundation and erection charges, also in sizes above 100 H. P. a jet condenser is included.

WORKING COSTS IN SMALL POWER PLANTS

BY

T. E. LOVE, M.I.E., (Ind.)

CHART I



Gas and Oil Engines are complete with producers in the case of Gas Engines, all piping, cooling tanks or cooling towards for large sizes, foundations and erection charges also in the large sizes compressed air starting arrangements are included.

In no case has the cost of engine house, boiler house or producer shed been included or the cost of transport from the seaport to the engine site, but this is about the same for Steam and Gas Engines and somewhat less for Oil Engines.

In taking the power of any engine the continuous working power for India is taken for Internal Combustion Engines this being 15% below the maximum load; and for Steam Engines their economical load which is 20 to 30% below their maximum.

Interest on capital outlay is taken as 6% in all cases, but depreciation varies with the type of plant, the following figures may be considered as a very useful basis to work on :—

Type of Engine.	Depreciation % per annum.	Life in years.
Gas and Oil Engine including gas plant ...	10%	10
Steam Engine with separate boiler	6%	17
Portable or semi-portable Steam Engine ...	8%	12½

Engines can be found working satisfactorily much older than the life given in the last column, but the point is that with the modern progress of engineering it often pays to scrap an old engine before it is worn out and install one of a later type.

In calculating the capital cost per B.H.P. hour the working year is taken as 260 days of 9 hours or 2,340 hours and the capital charges divided by the working H.P. hours give the following figures which are plotted on the chart showing the total costs per B.H.P. hour of the various sizes and types of plants :—

Capital charges per B.H.P. hour, interest and depreciation.

	Working Horse-power.			
	25	50	100	200
	annas			
Steam Engine and separate boiler	...	·29	·26	·25
Portable Steam Engine	·34	·29	...	...
Gas Engine and wood producer	·53	·43	·38	·36
Gas Engine and charcoal producer ...	·47	...	...	...
Solid Injection Oil Engine	·38	·32	·29	·27

THERMAL EFFICIENCY.

Before proceeding further with the actual running costs it is of great interest to compare the thermal efficiencies of the various types, that is, the mechanical heat equivalent of the work done divided by the heat units supplied in the fuel and through these figures check the actual fuel consumptions. Small Steam Engines are notoriously inefficient and it is only in the largest steam turbo plants that the thermal efficiency anywhere equals that of a Gas Engine and Producer and never that of an Oil Engine it being about 17 to 19%.

In considering the efficiency of steam plants the boiler and the engine have to be first taken separately, there are far more available heat units wasted in the boiler house than in the Steam Engine and yet it is the custom to put any sort of man in charge of the boiler and furnace.

The following are the average efficiencies of small boiler plants and Steam Engines :—

Type of Boiler.	Thermal Efficiency.
Small Cornish or Lancashire without Economiser	50—55%
Larger Lancashire with Economiser ...	55-65%
Small water tube without Economiser ...	55—60%
Larger water tube with Economiser ...	60—70%

Type of Steam Engine.	Pounds of Steam per B. H. P. hour.	Thermal efficiency.
Small simple non-condensing	32	7%
Larger simple condensing	26	9%
Compound non-condensing	24	10%
Compound condensing	19	11%
Special quick cutoff engine of at least 250 H. P.	17 to 18	13%

Thus the combined thermal efficiency of the boiler and Steam Engine varies from about 3½% in the smaller plants to 9% in the larger. These efficiencies are with saturated steam and would of course be improved if the steam were superheated.

In suction gas plants the thermal efficiency varies but little from the smallest to the largest size, it being about 70 to 73% with wood and wood-refuse and 75% with charcoal fuel, the Gas Engine has an efficiency of 22--26% thus the combined efficiency of the whole plant is 15½ to 19%.

Oil Engines are rather better than Gas Engines and modern engines on economical loads give approximately the following efficiency :—

Kerosene low compression	... 20—21 %
Solid Injection Engines using liquid fuel	... 25—30 %
Diesel Engines high compression	... 29—33 %

The above efficiencies are not the best which are sometimes used in selling engines but are satisfactory under good working conditions.

FUELS.

In the preparation of these costs the prices of fuels available in the United Provinces have been taken, these are Bengal coal wood, charcoal, liquid fuel and kerosene and it is instructive to note the cost of heat units in each case :

1. Bengal coal costs to small users Rs. 21 to 22 stacked in yard and contains about 9,000 B.T.U's. per lb. and 40% ash.

2. Firewood from the Forest Department can be supplied at about Rs. 30 per 100 maunds at siding and if cartage, loss in transit and cutting charges be included, it works out to about Rs. 13 per ton, allowing for a 30% moisture content the heating value is about 5,200 B.T.U's. per lb.

3. Charcoal of good quality can be procured in the cities at 32 lbs. to the rupee and in many of the outstations for much less the average heating value can be taken as 11,000 B.T.U's. per lb. when dry.

4. Liquid fuel can be supplied at almost any centre at 10·5 annas per gallon, each gallon weighs 8·7 lbs. and the calorific value is 17,500 B.T.U's. per lb.

5. Kerosene or illuminating oil in bulk is delivered at Re. 1 per gallon of 8 lbs. and has a value of 18,500 B.T.U's. per lb.

Tabulating these fuel costs with their heating value, the following is the cost per therm. or 100,000 B.T.U's. :—

Fuel.	Cost per unit.	Thermal value per lb.	Cost annas per therm.
Coal ...	Rs. 21-8-0 p. ton	9,000	1·7
Wood ...	Rs. 13 p. ton	5,200	1·8
Charcoal ...	Re. 0-0-6 p. lb.	11,000	4·5
Liquid fuel ...	Rs. 0-10-6 p. gal. of 8·7 lb.	17,500	6·9
Kerosene ...	Rs. 1 p. gal of 8 lbs.	18,500	10·8

FUEL COSTS.

In arriving at the actual running cost for fuel an allowance has to be made for stand-by losses and wastage and in the following table is given what are approximately good consumptions,

under Indian conditions, in the last column is shown the cost per B.H.P. hour including stand-by losses :—

Engine.	Fuel.	Consumption per B.H.P. hour. lbs.	Consumption including stand-by losses per B.H.P. hour. lbs.	Thermal efficiency. %	Cost per B.H.P. hour. annas.
				%	
Steam small simple ...	Coal	8	9	3½	1·38
Steam simple condensing ...	Coal	5	5·75	5½	·84
Steam compound non-condensing	Coal	4·5	5·25	6	·80
Steam compound condensing ..	Coal	3·5	4	8	·61
Steam portable ..	Wood	15	16	3¼	1·5
Gas and producer ..	Wood	3·2	3·5	15½	·32
Gas and producer larger ...	Wood	2·6	2·9	19	·27
Gas and producer small ...	Charcoal	1·25	1·4	16½	·70
Oil solid injection ...	Liquid fuel	·59	·6	25	·725
Oil solid injection larger ...	Liquid fuel	·48	·49	30	·60
Oil small ...	Kerosene	·69	·7	20	1·40

The consumption for Diesel Engines will be slightly better than those given for the Solid Injection Oil Engine, the latter type of engine is sometimes known as the Semi-Diesel.

WATER-SUPPLY.

Before deciding on any particular type of power plant the question of plentiful supply of water in the case of Steam and Gas Engines with wood producers is of the utmost importance and for the purpose of this paper the water-supply is taken as gratuitous. In the capital cost all cooling arrangements necessary for the jacket water in Internal Combustion Engines are included such as tanks for the smaller engines or cooling towers and pumps for the larger.

The following table gives the approximate water consumption in this country:—

Type of Engine.	Water consumption per B. H. P. hour including that lost by cooler evaporation in gallons.
Steam small simple	3·5 to 4
Steam simple condensing	3 to 3·5
Steam compound non condensing	2·5 to 3
Steam compound condensing	2·25 to 2·5
Gas Engine with wood producer	5·5
Gas Engine with charcoal producer	2
All types of Oil Engines	·3 to ·5

In the case of the Gas Engine with the Good Producer about 5 gallons per B H.P. hour are used in cooling and cleaning the gas before it enters the engine; with suitable filtering tanks, this consumption can be reduced by one-half, but it is not advisable to go further although the effluent is absolutely harmless it is not altogether good for vegetation and crops.

LUBRICATION COST.

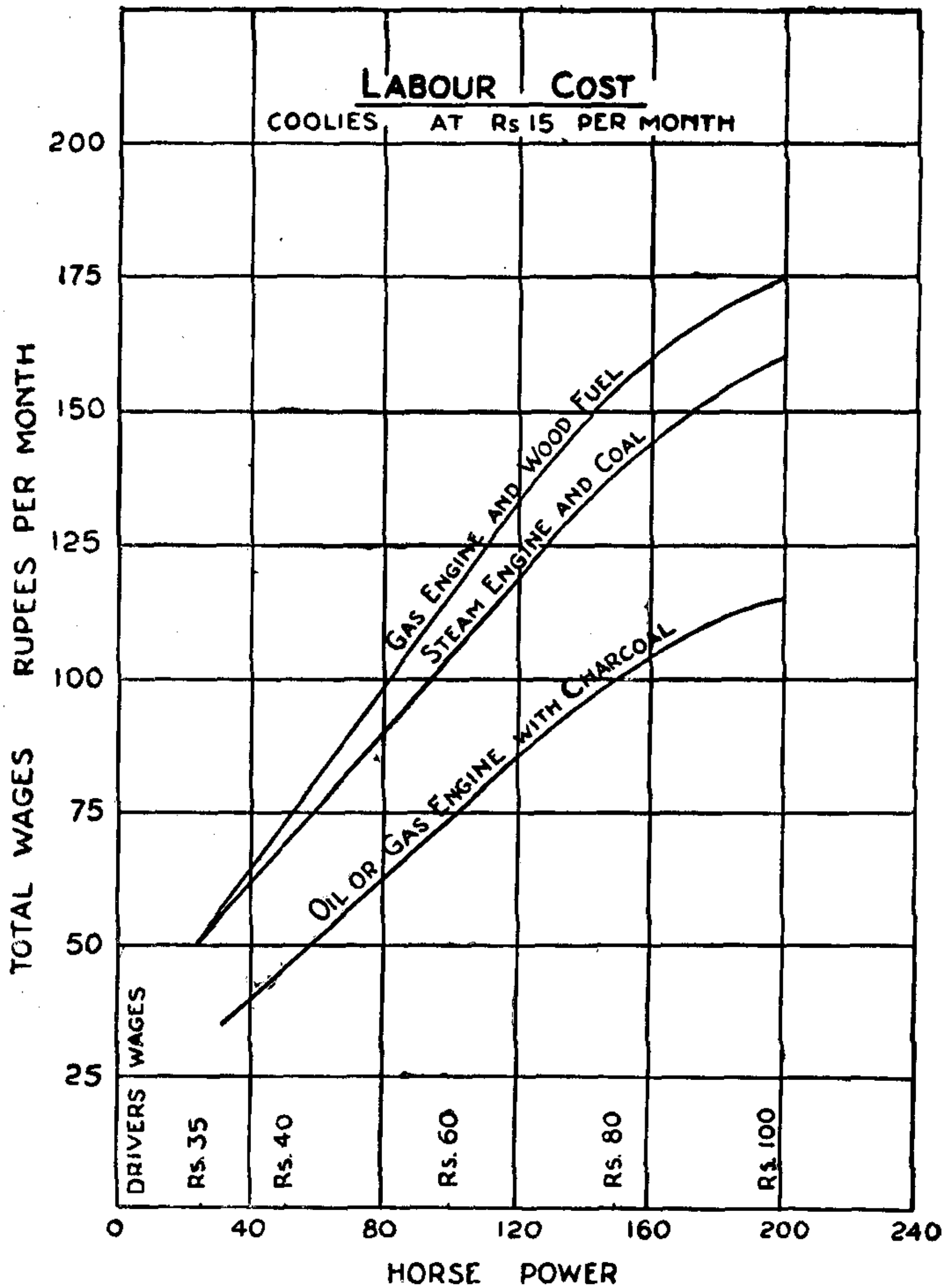
This is often a very difficult cost to estimate as usually there is a most unnecessary waste. Steam Engines with saturated steam can use a cheaper oil than Internal Combustion Engines and in all types a considerable saving can be effected by filtering and re-using the oil. For the purpose of these costs oil is taken as being delivered at the engine house at Rs. 3-8 per gallon for steam and Rs. 4 per gallon for Internal Combustion Engines.

WORKING COSTS IN SMALL POWER PLANTS

BY

T. E. LOVE, M.I.E., (Ind.)

CHART II



For engines between 25 and 200 H.P., oil consumption and costs should not exceed the following per B.H.P. hour :—

Type of Engine.	Horse-power 25—200.	Horse-power 25—200.
	Pints per B.H.P hour.	Annas per B.H P. hour.
Steam	·009—·005	·063—·035
Gas	·009—·006	·072—·048
Oil	·010—·006	·080—·048

Makers will, of course, guarantee for better figures than these and with totally enclosed engines are very easily obtained, with the open type of engine the driver is usually splashing the oil about especially if his employer is anywhere near.

LABOUR.

For estimating labour costs there is appended to this paper a chart giving approximate costs per month for driver, fireman and coolies. It will be noticed that labour is slightly more for a Gas Engine and wood-using producer than for a Steam Engine with coal fuel, this is due to extra cleaning at the week-ends, but actually it is easier work charging a producer than firing a boiler as all that the man in charge of the producer has to do is to keep it full. If wood fuel is used for raising steam much more labour is required unless some sort of mechanical transport is arranged.

To arrive at the labour costs per B.H.P. hour all that is done is to divide the cost per month by the average H.P. hours which work out approximately as follows for power between 25 and 200 :—

Type of Engine.	Annas per B H P. hour.
Steam with coal fuel	·17 to ·065
Gas with wood fuel	·17 to ·070
Oil or gas with charcoal fuel	·10 to ·045

With larger powers than 200, labour cost will remain about that given in the latter column or very slightly less.

STORES AND REPAIRS.

These are taken as a percentage of the capital cost and this is not far out with ordinary attention over the whole life of the plant, it being:

3% for Gas and Oil Engines.
2% for Steam Engines with fixed boilers.
2½% for semi-portable or portable Steam Engines.

TOTAL POWER COSTS.

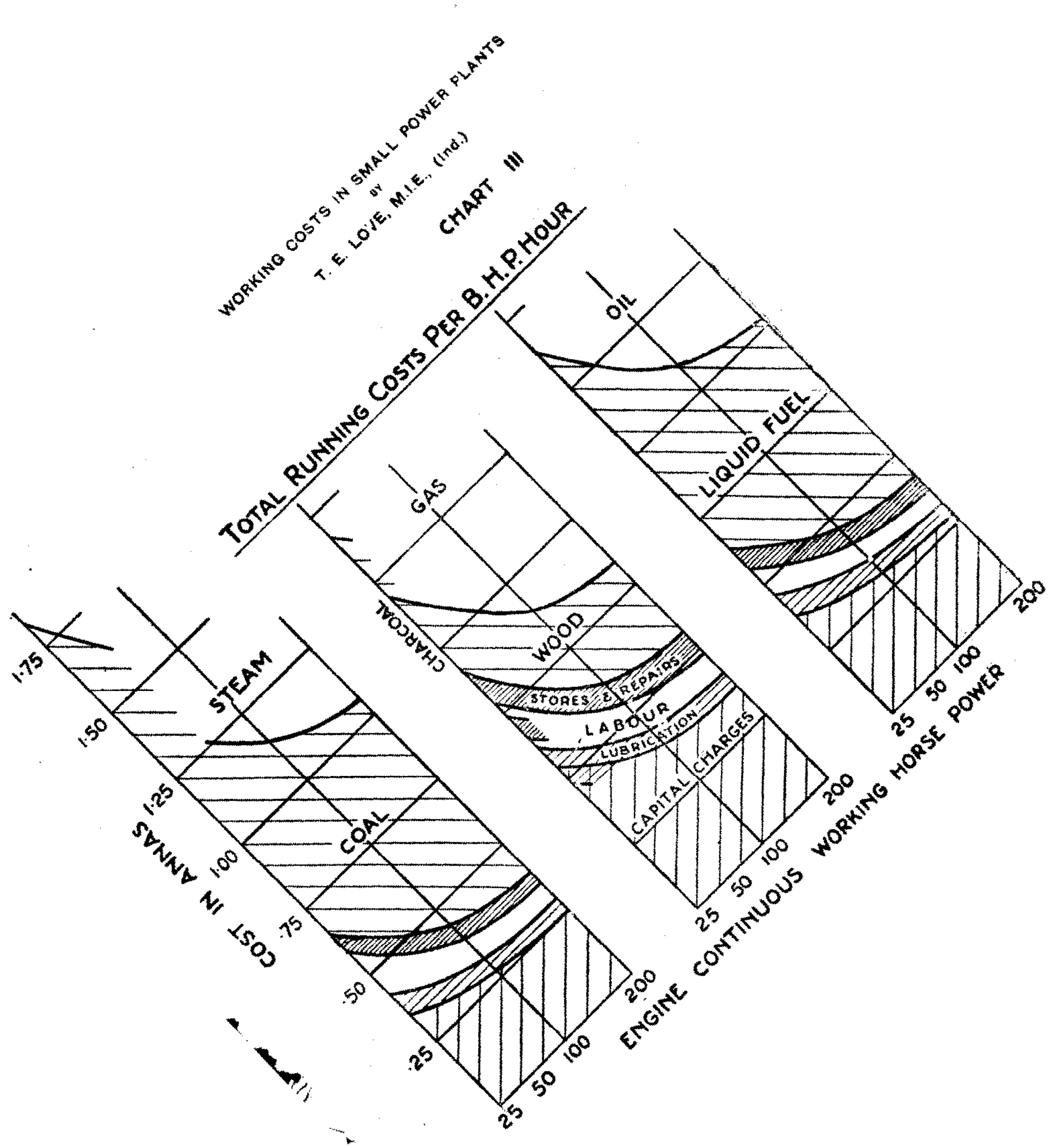
In the accompanying chart III is shown the cost in annas per B.H.P. hour for steam, gas and oil. Each item of expenditure being shown by dividing lines, thus reading from the bottom to top are capital charges, cost of fuel, lubrication, labour and stores and repairs; these figures tabulated are shown in the following table:—

TOTAL RUNNING CHARGES PER B.H.P. HOUR.

Working horse-power	25	50	100	200
Type of Engine.	Annas.			
Steam Engine and separate boiler ...	......	1·26	1·135	1·04
Portable Steam Engine	1·83	1·613	......	......
Gas Engine and wood producer ...	1·197	1·009	·895	·828
Gas Engine and charcoal producer ...	1·437	......	......	......
Solid Injection Oil Engine	1·350	1·181	1·087	1·013

Although these differences do not look very large they look much more when multiplied by the H.P. hours per year. Taking a 100 H.P. plant the total running costs per annum are:—

	Rs.
Steam	16,600
Gas	13,100
Oil	15,900


WORKING COSTS IN SMALL POWER PLANTS
BY
T. E. LOVE, M.I.E., (Ind.)
CHART III
TOTAL RUNNING COSTS PER B.H.P. HOUR
STEAM
COAL
GAS
CHARCOAL
WOOD
STORES & REPAIRS
LABOUR
LUBRICATION
CAPITAL CHARGES
OIL
LIQUID FUEL
COST IN ANNAS
1·75
1·50
1·25
1·00
·75
·50
·25
25
50
100
200
ENGINE CONTINUOUS WORKING HORSE POWER

showing a saving of about 21% for gas over steam and 17·5% for gas over oil.

Further, in the case of Gas Engines there is revenue from the sale of the wood tar which is collected from the tar extractor. This has not been taken into account but with a plant of 100 H.P. should bring in at least a hundred and sixty to two hundred rupees each year possibly more depending on the species of wood used.

CONCLUSION.

If a power plant is required at a factory where the waste products are of a combustible nature such as saw dust, wood chippings, tan bark, spent oil seeds, rubber seeds, tea prunings, etc., the Gas Engine and gas plant are the obvious thing to install as the fuel costs will be reduced to one-half or one-third of that shown in the chart.

In the process of some manufactures steam or hot water are required and if so it is quite a simple thing to install exhaust water heaters with all sizes of Internal Combustion Engines above 40 to 50 H.P. and exhaust heated boilers with Gas Engines above 70 H.P. An exhaust heated boiler with a Gas Engine will give about 1¾ to 2 lbs. of steam at 100 lbs. per sq. inch per B.H.P. hour and a water heater about 1 gallon of water at 200° Fh. from 60° to 70° Fh. per B.H.P. hour, this without any expenditure in fuel and very little attention.

Appended to this paper are three charts.

INDIAN TIMBERS SUCCESSFULLY USED FOR MOTOR BUILDING.

In accordance with my promise made at the Coventry Meeting my works have constructed two Motor Bodies made of Colonial timbers. Both have been on exhibition at our show rooms, 28 Brook Street, London, W., during the whole of the Motor Show week and are available for a further fourteen days for the inspection by those members who probably could not spare the time during so busy a week.

The four-door Landaulette in wood and aluminium, is fitted on a Daimler Chassis and is built exclusively of Colonial timbers.

White Bombwe.
" Mahogany.
" Chuglam.

The polished wood work in the interior is of Indian burr walnut and the mouldings Indian laurel.

We found in working these timbers that they machined up well, similar to mahogany; the weight comes out about the same as English ash, there is a great saving in marking out, the planks being square edge, various thicknesses, good lengths and very free from knots. These timbers are obtainable in London from the large stocks held by Messrs. Howard Bros., the Crown Agents for Indian timbers to the Government of India.

Report on Colonial Timbers.

The present prices are :—

White Bombwe	...	Rs. 6-0	per. cube.
" Chuglam	...	" 6-6	" "
" Mahogany	...	" 7-0	" "
Gurjan ...	...	" 7-0	" "
Teak ...	...	" 9-0	" "

The Two Seater All-weather body on the Whitlock Chassis is built of Colonial woods supplied by the Timber Advisory Committee of the Imperial Institute. The body is unpanelled and is constructed of—

Crabwood from British Guiana.
Iroko from Nigeria.
Sapeli Mahogany from Nigeria.
Gurjan from India.

These timbers we found of varying weights and degrees of hardness. With the exception of Iroko all machined well and are very similar to mahogany in appearance. I am not in a position at present to furnish the market prices of these woods,

but with the help of my colleagues on the Timber Advisory Committee to whom I am submitting the body at a later date for their inspection, I hope to be able to do so at a later date. I can, however, say that the Iroko employed is far too hard and not quite suitable for our trade as it has a white streak in it which recurs in different portions of the planks, harder than cement which destroys the tools. It is a nice wood and I have communicated with the Nigerian Government to know if it is peculiar to the planks supplied to me or is it a general blemish. They have replied that it must be peculiar to the particular planks supplied to me as it is unusual. This timber is largely used for counter tops and the interior decoration of offices, etc.

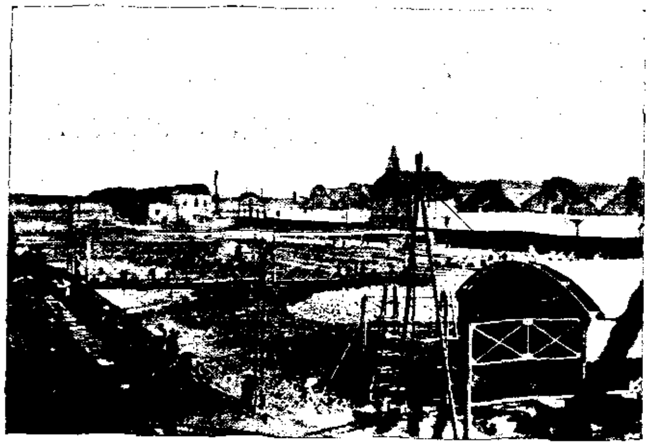
I am convinced of the suitability and excellence of the Indian timber for the construction of motor bodies. In my opinion it is better, cheaper, and more economical: there is a good deal less waste and I commend it to the industry with every confidence of it giving every satisfaction. No longer is it necessary to employ American ash, chestnut and other foreign timbers. Hundreds of thousands of pounds are being spent annually with foreigners. Believe me, within our Empire, on the *London and Liverpool wharves are more suitable, less expensive* and better Colonial timbers.

I would like to express my appreciation of the great help our industry has received from the Committee of the Timber Advisory Board of the Imperial Institute and the officials and permanent staff who have been most helpful and are always desirous of doing all they possibly can in the interests of our ndustry. I wish to place on record my high appreciation of their untiring efforts in this direction.

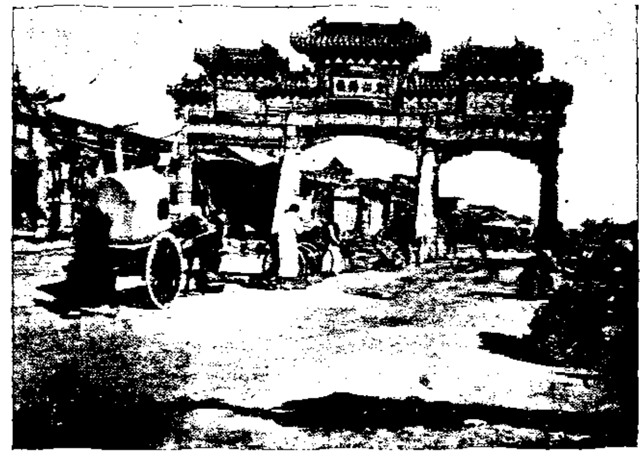
W. LAWTON GOODMAN,

President,

Institute of British Carriage and Automobile Manufacturers,

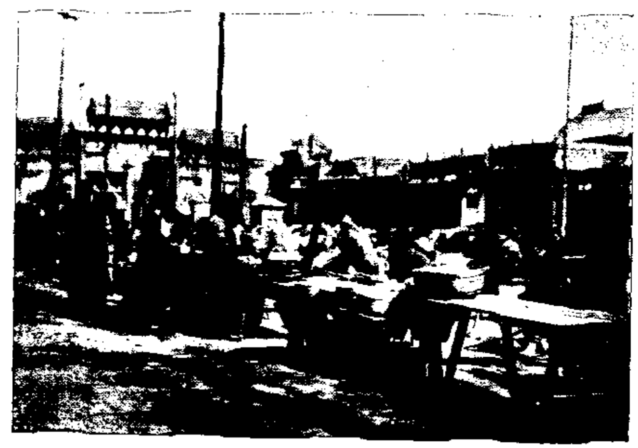


1. Jetties at Haiphong.



2. Archway near East Gate, Peking.

3. Temple courtyard, Peking.



4. Roadside eating-stalls, Peking.

Photos by W. A. Robertson, I.F.S.

VOLUME L NUMBER 6.

INDIAN FORESTER

JUNE 1924.

MORE RANDOM NOTES FROM EASTWARDS ROUND.

[CONTINUED FROM "INDIAN FORESTER," *XLIX*, *JULY* 1923, *pp.* 335—342.]

Our next port of call was Haiphong and I have always regretted that we had to make the trip by sea, for everyone agreed that the land route along the coast of Annam is one of the finest in the world. Unfortunately the road along which we went in our last forest trip from Saigon has not yet been carried right through to Hanoi, though a few years will see it completed.

Our stay at Haiphong was too short to allow us to get out to the Bay of Along, which from its pictures looks as if the most fantastic of Chinese artists had been allowed to fashion an archipelago after his own designs, so we had to content ourselves with a glance at the town, which struck me as the most official looking of any I have seen anywhere. Haiphong has one point in its favour; coaling ship there is the cleanest operation in that line that I have seen and a very pleasant surprise after most Eastern ports.

The remainder of the trip to Shanghai was not particularly interesting except that the scenery along the northern approach to Hong Kong harbour gave one a foretaste of the extraordinary charm of the scenery in China.

It may be as well to warn any foresters who propose to go up the China coast in February to be prepared for cold. From Haiphong onwards it got steadily colder, till by the time we were anchored off the mouth of the river waiting to go up to Shanghai, I should not have been in the least surprised to hear

that there were icebergs about. Shanghai is said to possess the longest bar in the world, which may be so though I did not have the chance of seeing it, but I can guarantee that it also provides the most searching brand of damp cold to be found anywhere outside the British Isles.

In fact my recollections of Shanghai are not particularly happy, more especially as my companion elected to go down with enteric at this point. Between the disgusting cold and the business of getting him into a nursing home, I had not much chance of enjoying the beauties of the place and I was not sorry to start off to Peking. I regret to have to confess that I "did" Nanking is true globe-trotter style, but I enjoyed it, in particular my introduction to the North China, urchin, a most engaging specimen of miniature brigand, whose comical appearance in his wadded coats and irresistible grin compel one to give him something. A swarm of them beset me as I entered the Ming Tombs and pursued me round much of the way and I realised that sooner or later I should have to give in, but managed to hold out until I got out again, when I jumped into the carriage pressed some assorted coppers into the hands of the smallest and cheeriest of the gang and told the driver to go like blazes while an immense wail went up from the disappointed.

This day also taught me that a wise man will take the same view of Chinese money that the Saxons took of arithmetic before the Conquest, namely, that it is beyond the power of the human mind to deal with, and will simply take thankfully what the bank is pleased to give him, or any one else for that matter. One may assume that perhaps the shroff of the bank knows exactly what happens when a misguided individual in Shanghai asks for Peking notes against his letter of credit, but I do not suppose that anyone else can except the worthy in the A.G's. office who cooks up our leave salary bills. I dimly apprehend that you take sterling and turn it into taels, which brand I never made out, and turn them into dollars and discount them again for the Peking brand of the latter, but beyond leaving with the conviction that I had always got less than my due, my transactions with the banks are swathed in mystery to me. When you come to

calculating how much change in "small money" you should get for a payment in "big money" at any particular place, the definitions of the Athanasian Creed are lucid compared to those of the local value of the dollar. The nett result is that you receive an assortment of picturesque coins hailing from places you never heard of and a large percentage of them will turn out not to be current in the next town, if not in the next shop. They say there are *three million money* barbers of sorts in China. I wonder there are not more for it must be a paying game when you understand it. On the other hand learning it is expensive.

Before starting for Nanking, there was news of a big railway strike at Hankow and there was some uncertainty that the Nanking-Pukow ferry would run in connection with the trains, so I was advised to take the lower ferry which was not likely to be affected by the strike, which I did although I had some doubts about getting my baggage across seeing *that I could not speak* a word of Chinese.

The launch was packed with people and towed alongside a flat even more densely crowded. Halfway across the launch stopped and began to drift down stream, while there appeared to be a certain amount of commotion amongst the crew. I began to wonder whether the strike had come down to Nanking and whether the crew had seized this opportunity to make a start. For several minutes I must confess that I felt quite uncomfortable, for I did not at all fancy finding myself on the beach of the Yangtse several miles below Nanking not knowing a word of the language, even though I knew that foreigners are usually left out of any domestic rows in China. However it turned out that they were merely stopping to cast off the flat from alongside and tow it astern, so with some relief I turned to a Chinese schoolboy who was sitting next me and had been trying to attract my attention to his school-books. One of them was a sort of spelling-book with the picture of an object on one side and a character on the other. It occurred to me that some words in Shan are the same as in some dialects of Chinese and that I would see whether he would recognise them. The result was most successful and we mutually beamed with smiles while

the crowd round us which had grown much denser during the experiment beamed in sympathy. In return I had to demonstrate the working of my camera and arriving at the shore we broke up with much smiles and hand-shaking. Incidentally neither o us could speak a word of the others language. Landing on to the pontoon was a splendid scrimmage, oncomers and offgoers charged each other blindly, and I had occasion to save a small girl from a very chilly bath in the river. The confusion was increased by a party of soldiers escorting a very frightened looking individual on the ferry, and for a time I thought that several people were bound to be pushed into the river, but we all managed to get off in the end. I should have liked to have found out who the frightened escorted one was, whether he was merely some successful official with his usual escort, or one who had backed a loser in the political game and was off to pay for his bad judgment against a wall.

My prudence in taking the other ferry was rewarded with a couple of hours' wait on an icy platform scourged by a piercing wind followed by a further wait in an unheated train until the train ferry eventually did arrive, which resulted in my getting the finest chill in my life. Moral : never be prudent again.

If my recollections of Shanghai are cold and unhappy those of Peking are cold and of the happiest, but where the cold of Shanghai was damp and penetrating that of Peking was bone-dry and bracing, only when the wind blew in off the desert, fur caps fur gloves and ear-muffs seemed most desirable for at times it felt as if one's face was being rubbed with sandpaper.

Of all the towns that I know in the East, Peking is the most interesting and the most fascinating. To look at it is not striking for there are no very conspicuous buildings but it contains a host of delightful glimpses and it is a joy to walk about and see the life on the streets. There is no need for me to describe the place, any guide-book will do that with much greater accuracy. What pleased me was to go to places which the guide-book does not mention, to which my hosts, the kindest of people, took me.

Single-handed I went only to the Great Wall and the Ming Tombs. The only thing to be said about the first is that it makes

you feel microscopic, and the second led me to make myself guilty of the crime of breaking into a tomb. Under old Chinese law the penalty is probably slow and painful, I imagine, but I gather that the offence is not extraditable.

From Nankow I set out on a rather diminutive donkey driven by a cheerful looking boy and we proceeded for a number of miles over dry stony country, where the roads were mere ribbons of loose pebbles crossed by frozen streams, urged on by the donkey-boy's dreary repetition of "*Tak Oi*" which had about as much effect on the donkey as the abbess mystic words had on the mule in Tristram Shandy. After twelve miles of rather dreary country only enlivened by three hamlets, innumerable magpies and a few clumps of stunted pines growing exactly as the Chinese artists depict them, we got to the big gateway at the end of the Sacred Road leading to the tombs. There I got off, being too cramped with sitting on the saddle, for it seems to me that you need to be as tough as the Chinese to have any comfort on their saddles, and walked ahead down the avenue of strange stone beasts. No doubt it would be prettier in spring, but there was something very impressive in the open dry plain and dusty wind whirling about the monuments. "So much the wind has borne away."

I soon lost sight of the donkey and, of course, when I got near the tombs, took the wrong turning and landed up at a smaller tomb about a mile off my course, but managed to get to Yung Lo's tomb at the same time as the donkey-boy. Then there was a hitch. There ought to have been a caretaker to show us in, but the huge door was shut and no one was about. The donkey-boy yelled and nothing happened, I bellowed and nothing happened, then a pedlar turned up from nowhere who had business with the caretaker and he yelled and nothing happened, finally we all yelled and hammered on the door with the same result.

The donkey-boy and the pedlar held a long talk, the gist of which was, I gathered from signs, that the caretaker was up at another tomb, and that the pedlar would go there and send him down. So he left us gazing furiously at the gate, for to my

reckoning after he had got to the other tomb, finished his business with the caretaker and the latter had got down to us, it would be night for it was then getting on for four o'clock.

At length, peering in despair through the cracks of the gate to try and see something of the interior, I noticed that the gate was shut only by means of a heavyish strut propped against it, and it struck me that as the caretaker would obviously not have climbed over a twenty foot wall after closing the gate there must be some other way of getting through the gate itself. After a search I found a loose plank rather cunningly fastened with a bent nail, which I promply took out, reached in and pushed down the strut. The look of delighted admiration which I caught on the donkey-boy's face as I did this was worth having lived to receive. It was the unstinted tribute from a master of mischief to one whom he considered to be a super-maestro in his own line of business. We then entered in triumph.

On the way out we met the caretaker into whose hands I promptly thrust the official fee, not that I bore him any gratitude but because having once pocketed it he had condoned the offence, and I could then majestically wave away his clamour for more, and make a dignified retreat.

The road home was rather a *via dolorosa*. It got steadily colder and darker, while gritty whirls of dust and snow blew up off the plain. In fact we should have made an excellent study for a romantic picture of "Lost in the Gobi." The cries of "*Tak Oi*" dwindled to silence and the donkey-boy fell back on his next line of offence, which consisted in prodding with the butt of his whip the portions of the donkey most accessible from astern. Later I discovered that the butt was spiked. In this way the donkey's pace was certainly improved, but when the most vulnerable spot was goaded there resulted a series of epileptic bounds which nearly maddened the rider. A Chinese donkey-saddle in those parts is a flat circular platform covered with a rug and furnished with very short stirrups. When one's feet have lost all feeling and one is stiff with cold and aching from the cramped position, to be bumped like a pea on a grid goads

one to murder. I very nearly got off to slay the donkey-boy but had to stay my hand. If the donkey-boy were dead or fled, how was I to get back? To sit facing the tail and prod the donkey would be ignominious in position and undignified in action. To follow the road on foot through the boulders was to invite a sprained ankle, and I have never understood how the donkey got along. To strike across unknown country in starless darkness with the chance of hitting a thin patch of ice on one of the rivers seemed to be merely foolhardy, so there was nothing for it but to stick by the donkey-boy.

Well, after dark when we seemed to have been travelling many hours, we met the first folk whom we had struck on the return journey, who turned out to be a search party sent out from the railway-hotel, and shortly after it was intimated to me that the donkey-boy would leave us and the necessary tip would be acceptable. He was welcome to it for he was a cheerful rogue and had had a weary trudge of it.

Even after we got to within sight of the lights of the town it seemed an endless time before we got to the hotel after threading our way over railway-tracks and round caravan-inns. I must confess that by the time we got to the hotel I had lost all interest in everything but, arrived there, and after something to warm me up, I felt that the day could best be summed up in the words of an old and exceedingly disreputable acquaintance of a friend of mine, who once remarked, "Yes, Mr. ———, its been the hell of a life but, mind you, I wouldn't have have missed it for anything." Nor would I.

W. A. ROBERTSON, I.F.S.

NOTE ON THE STRENGTH, TREATMENT AND DURABILITY OF SAIN (*TERMINALIA TOMENTOSA*) SLEEPERS.

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PART I.

A BRIEF REPORT ON THE STRENGTH CHARACTERISTICS OF *TERMINALIA TOMENTOSA* AND THEIR BEARING ON ITS PROBABLE USEFULNESS FOR RAILWAY SLEEPERS.

This report relates to the first series of tests undertaken under *Project No.* 4, "*Mechanical Strength*, Seasoning Properties, Treatment of and Key to certain Indian Sleeper-woods."

The object of this part of the work is to obtain data on the strength, elasticity and spike-holding power of the wood, and for this purpose two lines of investigation are followed. First, information is collected on the strength and elasticity of the wood, and second, tests are made of the stress necessary to withdraw standard railway dog-spikes when driven into pre-bored holes of various diameters.

In collecting strength data, if a timber to be studied in this investigation has already been subjected to the standard routine tests this information, which is full, reliable, and final is used. If such data be not available a number of similar tests are made and the results tabulated. This, though not final, is sufficient to give a really good indication of the probable fitness so far as strength is concerned of the wood for use as sleepers. Fortunately in the case of *Terminalia tomentosa* (Ver. *sain*, *matti*, *asna* or *taukkyan*), the results of routine tests are available.

In the tests of spike-holding power ordinary dog-spikes are driven into pre-bored holes of $\frac{3}{8}''$, $\frac{1}{2}''$ and $\frac{5}{8}''$ diameter, and then withdrawn in the testing machine, measuring for each increment of withdrawing stress the amount by which the spike has been

removed from the sleeper. This measurement is made correct to 0·00005 inch, as it has been found that there is a definite "*Elastic withdrawal limit*," or point up to which the withdrawal is proportional to the stress, and this degree of accuracy is necessary to detect the point. The importance of accurately locating the "Elastic withdrawal limit" lies in the fact that, stressed to any degree below that limit, when the stress is removed the spike recovers any slight withdrawal that the stress has caused, but stressed beyond that point the spike remains slightly farther out of the wood than it was at the beginning of the test.

As the result of many years of study of the application of strength tests to the problem of selecting sleeper-woods a "*Composite sleeper figure*" has been developed. This figure does not express any one property of the wood in physical units, but is a numerical representation of the "weighted and adjusted" average of all the strength properties of the wood that bear upon its usefulness as a railway sleeper. In the same table in which the "composite sleeper figures" are presented will be found the specific gravity, the side hardness, the compressive strength across the grain, and the spike-holding power both at the "elastic withdrawal limit" and at the greatest load necessary to remove the spike. It is thought well to present these values in juxtaposition to facilitate a comparison of the most important strength functions when considering the suitability of any wood for use as a railway sleeper. The great advantage of using the "composite sleeper figures" is that they are exactly comparable with the same figures prepared by the Forest Products Laboratory at Madison, U. S. A., for American sleeper woods.

Considering now the tables of results presented herewith *Table No. 1* (Plate 14) is a statement of the actual test results for all the Indian timbers that have so far been completely tested by standard methods under our Project No. 1. If it is desired to use this table to compare the strengths of any two species that part of the table entitled "Green Timber" must be used, because, if a timber contain less than about 30 per cent. moisture, its strength will vary very appreciably with changes of moisture content. When

timbers contain less than about 30 per cent. moisture their strengths can be compared if the moisture contents are nearly the same in the two woods under reference.

In *Table No.* 2. will be found the "composite sleeper figures" referred to above, with the other important functions written in the same line. In order to make all the strength figures in this table suitable for making comparisons between species, they have been corrected to their equivalent for wood having the same moisture content, *viz.*, 12 per cent.

TABLE No. 2. UNTREATED WOOD.

Species.	Sp. Gr. oven Dry.	Composite Figure.	Spikeholding power. Optimum size of pre-bore.	Spikeholding power. Load at E. L.	Spikeholding power. Load at Y. P.	Spikeholding power. Max. Load.	Comp. perpendicular to grain.*	Side Hardness.*	Remarks.
White Oak (U.S.A.)	0·59	1,040	...	...	...	...	1,300	1,365	
Teak (Malabar) ...	0·614	1,195	...	...	...	...	1,660	1,175	From Project I
Teak (Burma) ...	0·586	1,180	...	...	...	...	1,465	995	,,
(Sain) *Terminalia tomentosa.*	0·707	1,455	3/8"†	3,250	...	8,965	1,855	2,125	,,
(Kanyin) *Dipterocarpus alatus.*	0·574	1,040	...	...	...	...	1,280	1,030	,,

NOTE.—This table is prepared from the tests on untreated wood because the maps of data available is for wood in that condition, and because composite figures for foreign woods are based on the same condition, and consequently this table is the most useful for making comparisons. The tests on treated wood show that the treatment has not the least weakening effect.

Table No. 1 is included for reference only, and requires no explanation for the purposes of this report, except to say that it is from the figures contained in this table that Table No. 2 is compiled.

*The values correspond to strength at 12 per cent. moisture.

†Though the tests so far completed give an optimum value for ⅜ in. holes, they are small in number and a close observation of the behaviour of the sleepers under test and of the wood after test leads to the conclusion that the best size of hole to use is the ½ in. hole.

From Table No. 2 it will be evident that *sain* is superior in every respect to White Oak, one of the very best sleeper woods used in America, and decidedly so in its "composite sleeper figure." Thus, if its durability can be made satisfactory, a question discussed in another part of this report, it can be expected to make a sleeper in every way superior to White Oak, that is to say, superior to any imported sleeper that can be obtained at any price.

Unfortunately there are no figures available for the spike-holding power of White Oak, for though it has been tested in this respect in the United States the dog spikes, known as "Pensylvania Cut Spike," used in that country are of different design and size from the dog-spikes used on the Indian Railways. The following figures however are sufficient to prove that the spike-holding power of *sain* is more than sufficient to meet all railway requirements.

Table No. 3.

SPIKE-HOLDING TEST RESULTS

Species.	Condition.	Spike-holding power.		
		Size of hole	Load at E. L.	Max. load.
Douglas Fir ...	Untreated ...	1/2" ...	2,000 lbs. ...	3,070 lbs.
Deodar ...	,, ...		3,130 ,, ...	4,085 ,,
Pyingado ...	,, ...	3/8" ...	5,125 ,, ...	5,855 ,,
,, ...	,, ...	1/4" ...	6,950 ,, ...	7,830 ,,
,, ...	,, ...	3/8" ...	5,065 ,, ...	6,750 ,,
Sain ...	Untreated ...	3/8" ...	3,250 ,, ...	8,965 ,,
,, ...	,, ...	1/2" ...	3,165 ,, ...	6,845 ,,
,, ...	,, ...	5/8"	3,000 ,, ...	5,250 ,,
,, ...	Creosoted ...	3/8" ...	2,835 ,, ...	5,905 ,,
,, ...	,, ...	1/2" ...	3,165 ,, ...	5,495 ,,
,, ...	,, ...	5/8" ...	3,250 ,, ...	4,510 ,,

NOTE:—For *sain* the number of tests completed is still small and these figures may be subject at a later date to slight change. In some cases with the 5/8" hole individual spikes went above 4,000 lbs. at the Elastic Limit and to 9,700 at Maxium Load. In several cases the result could not be recorded as the spike itself broke, the holding power of the wood being greater than the strength of the spike.

Conclusions.

From the results of the tests it is obvious that the mechanical properties of *sain* are more than sufficient to meet the requirements of the very best wooden railway sleepers, being superior to those of White Oak, one of America's admittedly best sleeper-woods.

From the *appearance* of the spike-holding tests, in addition to the results quoted above, the writer is convinced that the best results will be obtained by driving the spikes into pre-bored holes of ½" diameter, whether using treated or untreated wood, but the difference in holding power for pre-bored holes of different diameter is unusually small in this species, and there is no objection to using either ⅜" or ⅝" holes, except that former rather increase the danger of splitting and had better be avoided for that reason. Re-driven spikes hold extremely well in *sain*, the first re-driving giving results almost equal to spikes driven for the first time.

The treatment used in this series of tests, as described in another part[1] of the report, gave exceedingly good penetration. The writer has never had to test wood that showed so complete a penetration, but there is no indication that it has had the slightest weakening effect on the wood. The slight variation between the results of tests on treated and untreated material lies well within the natural variation to be found in good timber of one species.

It was observed that it was somewhat easier to drive the spikes into the treated than into the untreated wood, and for this reason it was at first feared that the treated wood might not hold the spikes so well. The tests however proved conclusively that this was not the case, and that the spike-holding power of creosoted *sain* sleepers is extremely good.

PART II.

REPORT ON THE PRESSURE TREATMENT OF SAIN BROAD GAUGE SLEEPERS AT THE WOOD PRESERVATION PLANT, FOREST RESEARCH INSTITUTE, DEHRA DUN.

Sain (Terminalia tomentosa) is a very strong wood found in almost all parts of India and Burma. In Burma, Bombay and

Madras the timber is available in large sizes and quantities. The Chief Conservator, Bombay, estimates that about 7,500 B.G. and 75,000 M.G. sleepers will be available from the Bombay forests annually, for some years to come. Madras and Coorg can also supply large quantities, while *sain* is found in quantity throughout the deciduous and moist deciduous forests of Burma. The average life of such a strong and widely-distributed wood untreated, in the permanent way is only from 5 to 7 years, on the average, while with a proper pressure treatment of mixed creosote and earth oil (7 to 8 lbs. per cu. ft.) it is not too optimistic to reckon the life of the treated sleeper at about 15 years or the same average life as that of a Nepal *sal* sleeper. The price of *sal* to-day is in the neighbourhood of Rs. 9-8-0 per B.G. sleeper, while that of *sain* may be taken at Rs. 6 to Rs. 6-8-0. Thus, with an additional total cost of Rs. 2 to Rs 2-4-0 per B.G. sleeper, according to the capacity of the wood preservation plant and the relative proportions of creosote and earth oil used as antiseptic for treatment, it is anticipated that the life of the sleeper is enhanced by about 10 years It is easy to see how sound an economic proposition a treated *sain* sleeper is when compared to *sal* or *pyinkado*, both standard sleeper woods of India. Assuming an amortisation rate of 6 %, calculated on the actuarial basis, the economic cost per mile per year of treated *sain* is equal to Rs. 2,409, whereas, the corresponding figures for the two standard woods above referred to are Rs. 2,537 and 2,533 respectively.

PREVIOUS EXPERIMENTS.

This wood was treated by the Forest Economist 10 years ago, by boiling the sleepers in creosote for 24 hours in open tanks. The average absorption obtained was about 3 lbs. per cu. ft. Of 524 B. G. sleepers thus treated and laid in the G. I. P. Railway, Itarsi Nagpur Section, 507 are still in excellent condition, 9 are showing signs of cracking and 8 have been rejected. The sleepers are therefore doing extremely well and may be expected to last several years longer. The strength of this timber has been dealt with in Part I of this report and as it is

an extremely strong timber it is thought that with an absorption of 7 to 8 lbs. per cu. ft. the rejection of a pressure treated sleeper, due to want of durability will synchronise with the failure of the sleeper from mechanical abrasion, rail-cutting or spike-killing.

PRESENT EXPERIMENTS.

General.—Experiments were conducted recently in the Experimental Wood Preservation Plant of the Forest Research Institute, Dehra Dun, by treating *sain*, B. G. sleepers by the Full Cell pressure process, aiming at an averege net absorption of 7 to 8 lbs. per cu. ft., with the sleepers dry after treatment. In all, 220 B. G. sleepers were treated, of which, 40 were from Bareilly being *sain* from the U. P. forests, and the remainder extracted from the Bombay forests and treated on behalf of the B. B. and C. I. Railway, 5 were also handed to Timber Testing Section for strength tests. All the sleepers were pre-bored with $\frac{5}{8}''$ $\frac{3}{8}''$ or $\frac{1}{2}''$ holes according to the O. and R. R. or the B. B. and C. I. specification (the Bareilly ones being according to the O. and R. R.). Half an inch deep chisel identification marks were made on them to facilitate proper inspection of the sleepers for actual durability tests in the line. The general form of the chiselled marks is shown below :—

A, B, C, D or E.

T.T.

8—?

The letter A, B, C, D, or E indicates in each case the composition of the antiseptic use.

A	indicates a mixture of	equal proportion of coal tar, creosote and earth oil.
B	,,	1 part of creosote with three parts of earth oil.
C	,,	pure raw wood tar obtained from the Mysore Bhadravati Iron Works.
D	,,	a mixture of equal parts of the wood tar with earth oil.

E indicates a mixture 1 part of creosote with 2 parts of earth oil.

T. T. indicates the botanical name of the wood (*Terminalia tomentosa*).

8 is the number in the list of woods given in our specification for Project No. IV.

? is the serial number of the sleeper treated according to Project No. 4.

Table 4 gives the analyses of the (1) wood tar, (2) earth oil and (3) creosote and earth oil mixed, used in these experiments. It will be observed that the creosote conforms closely to the British standard specification, the wood tar contains a fairly high proportion of acetic acid and the earth oil appears to be fairly heavy.

Table No. 4.

ANALYSES OF ANTISEPTICS.

(1) Wood Tar.

Density = 1·108. Moisture = 5·8 %.

Acids soluble in Caustic Soda = 24·4 %.

Corrosive acids calculated as Acetic Acid (included in above figure) = 2·9 %.

Matter soluble in water calculated on original Tar = 17·9 %.

Distillation—

Up to 150°C	10·0%	235° — 245°C	5·2%
150° —170°C	1·0 „	245° — 255°C	8·4 „
170° —205°C	7·2 „	255° — 270°C	6·1 „
205° —225°C	7·3 „	270° — 280°C	2·1 „
225° —235°C	7·6 „		

Residue above 280°C was solid pitch = 45·1 %.

(2) Earth Oil.

Density @ 28°C = 0·876.

Distillation—

Up to 170°C	0·21 %	245° – 255°C	3·9 %
170° – 205°C	1·0 ,,	255° – 270°C	7·4 ,,
205° – 225°C	1·0 ,,	270° – 290°C	12·4 ,,
225° – 235°C	1·3 ,,	290° – 305°C	11·7 ,,
235° – 245°C	2·2 ,,	305° – 315°C	10·1 ,,

Residue above 315°C = 48·8 %

(3) *Creosote and Earth Oil Mixture.*

Density = 1·027. Moisture = 1·6 %.

Acids soluble in Caustic Soda = 5·5 %.

Distillation—

Up to 170°C	0·2 %	255° – 270°C	8·0 %
170° – 205°C	1·8 ,,	270° – 290°C	8·0 ,,
205° – 225°C	5·0 ,,	290° – 305°C	6·8 ,,
225° – 235°C	4·1 ,,	305° – 315°C	4·1 ,,
235° – 245°C	5·5 ,,	315° – 330°C	6·1 ,,
245° – 255°C	5·0 ,,		

Residue above 330°C = 45·4 %.

The U. P. lot Nos. $\frac{\text{T.T.}}{8-1}$, 3, 5, 6, 7, 8, 9, 10, 11, 13, 16, 20, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 34, 37, 40 and 45 of the Bombay sleepers Nos. $\frac{\text{T.T.}}{8-41}$ to 85 inclusive were treated with a mixture of equal parts of creosote and earth oil (A).

Another 45 of the Bombay lot Nos. $\frac{\text{T.T.}}{8-68}$ - 130 *inclusive* were treated with a mixture of 1 part of creosote with three parts of earth oil (B).

Nos. $\frac{\text{T.T.}}{8-13}$, to 160 were treated with Wood Tar (C).

Nos. $\frac{\text{T.T.}}{8-181}$ to 205 with Wood Tar and Earth Oil in equal proportions (D) and Nos. $\frac{\text{T.T.}}{8-206}$ to 220 with Creosote and Earth Oil in proportion 1 : 2 (E).

In each case, the average amount of antiseptic injected under pressure was 7 to 8 lbs. per cu. ft. and it remains to be seen if the extra cost due to the higher proportion of creosote is justifiable on economic grounds. Except the U. P. lot which are placed in the O. and R. Railway the others will be

removed to the B. B. & C. I. permanent way and annual inspections will be made. Till the experiments are closed, it will be impossible to predict accurately on the basis of the relative toxic values of the mixtures alone, which of the mixtures is the better economic proposition. *It should be remembered that creosote* costs about 80% more than earth oil. Considering the large numbers of sleepers that will be treated in the near future in commercial treating plants, it is essential that careful inspections should be made of these experimental sleepers, and cautious inferences be drawn *from the records to decide between them. It should* here be mentioned that experiments have shewn that earth oil by itself has very little preservative value and in these experiments is regarded solely as a diluent for the antiseptic oil.

MATERIAL.

The U. P. material of 45 sleepers were treated in three charges and the Bombay lot was treated in 12 charges of 15 sleepers each. Except for about 10 % of the sleepers treated, all had a moisture content of less than 25 % at the oven-dry weight at the *time of treatment.*

TREATMENT.

General.—All the *sain* sleepers with the exception of Experiment E in which the Lowry Process was used were treated by the Full Cell Process, the average temperature of the antiseptic was in general, 160° F. The average net absorption of the antiseptic was 21—24 lbs. per sleeper. The maximum pressure used during the impregnation was about 175 lbs. per sq. in. In no case was a higher preliminary vacuum given than 15" for more than 20 minutes, or a final vacuum of more than 0—13" beyond 15 minutes.

Though it is advisable to allow the pressure to rise steadily, in order to get comparative results with regard to the rate of penetration of different antiseptics at different pressures it was found necessary to maintain the pressure at predetermined values for identical periods of time by opening a by-pass on the pressure

3

pump and allowing the oil to flow back to the service tank instead of entering the cylinder and so building up the pressure beyond the value required. In general the treatment was as follows :—

The pressure cylinder was charged with 15 B. G. sleepers at a time and the door securely fastened. An initial vacuum varying from 0—10" to 0—15" was drawn, chiefly for expediting suction of oil into the cylinder and also, in addition, to suck out some air from the surface layers of the wood, thus facilitating penetration of the antiseptic into it, especially during the earlier stages of the pressure period. On opening a valve the antiseptic was allowed to rush into the pressure cylinder till it was nearly full, when the valve was closed and the vacuum destroyed. The cylinder was filled completely by pumping in more oil. When this was done the cylinder was completely closed and oil was forced in by a mechanical pump from a calibrated service tank. The oil pump was allowed to pump the antiseptic through a non-return valve into the cylinder. At first, the rise in pressure was slow, but subsequently, the pressure rose rapidly. It may be mentioned that as long as the rate of absorption by the wood is equal to the rate of the ingress of the oil, the pressure does not rise. But when this equilibrium is disturbed, and the pump forces in more oil than the wood can absorb in a certain time, the extra oil builds up a pressure. In all the experiments made with *sain*, the by-pass was first closed and the full delivery of the pump diverted into the cylinder. With the A and B mixtures the pressure rose in 5 mins. to 100 lbs. per sq. in. at which it was maintained for 5 mins. by adjusting the throttle valve in the by-pass. Subsequently, the pressure was raised to 125 lbs. per sq. in. which was maintained for 5 minutes and then raised to 150 lbs. per sq. in. at which value it was maintained steadily for 15 mins. The pressure was then allowed to rise (closing the by-pass fully) to 175 lbs. per sq. in. which was held till a gross absorption of 27—30 lbs. per sleeper was obtained. When the absorption was complete all the oil was expelled from the cylinder; the expulsion of the oil being expedited by forcing air into the cylinder. The level of oil in the service tank before and after the various stages of the pressure period was observed.

Finally, a light vacuum of 0—12" for about 12 mins. was drawn and the process finished by transferring any oil so drawn from the wood to the calibrated service tank. All the sleepers were individually weighed before and after the treatment, and their moisture contents noted.

Autographic recorders for temperature and pressure recorded the temperature and pressure conditions of the sleepers and the antiseptic during the various stages of the charge. In the Lowry Process the preliminary vacuum was not drawn, and the final vacuum was of half an hour's duration.

BOMBAY SLEEPERS FROM THE B. B. & C. I. RY.

200 sleepers sent for treatment from the B. B. and C. I. Railway were fairly well-seasoned at the time of treatment. They were utilised for a dozen charges to investigate the relative penetration of the various antiseptics above referred to (the remainder being rejected for original defects). In seven of the charges, the sleepers were impregnated with mixtures of coal tar creosote and crude oil, two with raw wood tar and three with a mixture of equal proportions of wood tar and earth oil and the remaining one with a mixture containing one part of coal tar creosote to two parts of earth oil.

Experiment 1.—The first lot of 45 sleepers were treated in three charges using a mixture containing equal proportions of creosote and earth oil. The pressure period was in general about 1½ hrs. Though the sleepers were well seasoned (average moisture content being 22°/₀), a preliminary vacuum of 0—15" was found to expedite absorption. There is no evidence to indicate that a preliminary vacuum would make the absorptions more erratic, when a fairly high absorption of 21—24 lbs. is secured. The average charging temperature for the three charges was 160° F. and this appears to be quite suitable for the treatment of this wood, the moisture content being below 25°/₀. The average specific gravity of the wood, based on air-dry weight of the sleepers was nearly 90.

Experiment 2.—The next lot of 45 B. G. sleepers with an average moisture content of 23°/₀ were treated in three charges

with a mixture containing 1 part of creosote and 3 parts of earth oil. A small quantity of pitch was precipitated, but it was neither excessive nor was it present in suspension to interfere with the penetration of the preservative into the wood, by blocking the pores. The average absorption for the three charges was slightly over 23 lbs per B. G. sleeper working on exactly similar lines to experiment 1, so that practically there is no difference as regards relative penetration between the two mixtures used. An average charging temperature of 160° F. was used. The penetration in both the above experiments was complete, oil appearing all through the wood. This may be considered as a most satisfactory result, as better penetration could not be desired.

Experiment 3.—Another lot of 30 B. G. sleepers with an average moisture content of 21 % was treated with wood tar in two separate charges. The same charging temperature of 160° F. was adhered to.

The absorptions appeared, under exactly identical conditions, to be about 20 % more rapid than in the case of the two mixtures of coal tar creosote with earth oil. But the depth of penetration was disappointing, being only about 20 % of that secured in experiments 1 and 2, though in the two charges of this experiment a total net absorption of 7 to 8 lbs. per cu. ft. was secured.

This is probably because wood tar as it penetrates into the cooler strata of the wood becomes less mobile, retarding further penetration into the wood. Inspecting the sections after cutting some of the treated sleepers, it was, as might be expected, found that though the longitudinal absorption was slightly better than the radial, the penetration had not exceeded 1" on the sides and 4—6" at the ends. The black solid tar and pitch could be seen blocking the pores of the wood. The importance, for this species, of the complete penetration of the antiseptic into all parts of the sleeper is very great, as, due to the greatly varying conditions of temperature and humidity coupled with the somewhat high shrinkage values of this wood, it has a tendency to crack in the railway line, exposing interior regions

of the sleeper to attacks from white ants, fungus, etc. All the sleepers treated in Experiments 1 and 2 satisfied this important condition.

An important objection to using raw wood tar for pressure treatment lies in its containing a relatively large percentage of bodies of the acetic acid type, which give rise to trouble with the plant. However, this is an objection that can be got over by suitable treatment.

Ignoring for the moment the relative toxic values of wood tar and mixtures of coal tar with earth oil, an objection to the use of wood tar alone is that despite high absorption values the penetration is low for the reasons cited previously.

Experiment 4.—The fourth lot of 45 sleepers with an average moisture content of 20 per cent. were treated in three separate charges with a mixture containing equal proportions of wood tar and earth oil.

Working on a similar specification for treatment to that used in the three previous experiments, the first day, the absorption appeared to be about 15 per cent. less rapid than in the case of wood tar. It may for all practical purposes be assumed that the rate of absorption obtained in this case was on a par with that obtained in the first two experiments. To secure an absorption of 7—8 lbs. per cubic feet 1½ hour of pressure treatment in accordance with the specification described before was found to be necessary and sufficient to give good penetration.

On the second day, to get the same absorption under exactly identical conditions with the first charge, a little over two hours of pressure period was found to be necessary, the average temperature of the charge was however only about 130° F. How far the slower penetration of the mixture was influenced by the lower charging temperature is not known at present, but it is thought it was most probably due to the presence of a large proportion of pitch in the mixture.

A day later, the third charge of Experiment 4 was conducted adhering to the previous specification. The pressure treatment was continued for 2½ hours and the absorption could not be

improved over 20 lbs. per sleeper. On examining the mixing tank a large amount of pitch was found at the bottom. With the agitation created by the suction of the pump, the precipitated pitch thickens the consistency of the charging oil, and this tends to block the pores of the wood.

It is noteworthy that an oil such as earth oil containing paraffins throws down a thick viscous bituminous substance when mixed with wood tar. The same phenomenon is observed with Crude Coal Tar but not with Creosote.

Experiment 5.—The last charge consisting of 15 B. G. sleepers with an average moisture content of 17 per cent. was treated with a mixture containing one part of creosote and two parts of earth oil. The same results were obtained as in Experiments 1 and 2.

Conclusions and Economic Considerations.—From the above experiments, *sain* appears to be easily amenable to pressure treatment. Coal tar creosote mixed with crude oil besides being an excellent business proposition, can be injected into the wood under pressure in about 1½ hours securing a net absorption of 7—8 lbs. per cubic feet, the penetration of the antiseptic extending to all parts of a B. G. sleeper A preliminary vacuum of 0—15 for about 15 to 20 mins. is beneficial, as the wood in question has long clear pores without tyloses. A final vacuum of 0—13" for about 13—15 mins. ensures not only the dryness of the sleepers after treatment, but prevents their "sweating" in summer.

It is a moot point however whether the saving in time for duration of pressure will compensate for the loss of time in drawing a preliminary vacuum. It should be remembered that no sleeper with a moisture content of over 25 per cent. should be treated except in very special circumstances and even then it should not exceed 30 per cent. Considering the high mechanical strength values of this wood, and the great difficulty of obtaining absorptions over 8 lbs. per cubic feet it is economical to secure a net absorption of 7—8 lbs. per cubic feet with uniform treatment. Following the specification indicated above, in a modern commercial wood preserving plant, equipped with efficient and independent air and oil pumps, three charges of the wood can be treated in a day.

PART III.

THE DURABILITY OF TREATED SAIN SLEEPERS.

The available information on the durability of treated *sain* sleepers has been dealt with in various reports issued from time to time by the Economic Branch of the Forest Research Institute. The latest information on the subject is given in Forest Bulletin No. 53 of 1924, a summary of which is given below :—

Species.	Treatment.	Time in the line.		Results according to classes.			
		Yrs	mts.	A per cent.	B per cent.	C per cent.	R per cent.
Sain, Terminalia tomentosa B. G sleepers, laid in different sections of the O. and R. and N.-W. Railways	Powellising	10	9	42·8	46·9	4·7	5·6
Ditto.	Treated in Open Tanks with a mixture of Creosote and Earth Oil.	7	0	85·7	11·1	1·7	1·5

Note —A.—Good in all respects.
B.—Slightly split, decayed or white ant attack slight.
C.—Badly split, decayed or attacked by white ants.
R.—Rejected.

The experiments are not complete, though the results to date clearly show that a treated *sain* sleeper to be an extremely attractive proposition. As a matter of fact we have some of this year's reports on these sleepers, that is a year later than those given above but as all the reports are not as yet in the composite figures cannot be given. The inspections so far show that the sleepers are much in the same state as they were last year. Taking powellised *sain*, of which we have the longest records, this year's records show over 85 per cent. *still* in *A* and *B* class, in other words sound sleepers which are expected to last at least 4 or 5 years longer. It should here be mentioned that an untreated *sain* sleeper lasts from 5 to 7 years, while the above results are of either powellised or of sleepers treated in open tanks.

From the results given elsewhere in this note it will be seen that this hard timber treats well under pressure, complete penetration being possible, and this factor makes the proposition the more attractive.

PAX BRITANNICA.

In looking through some old files the other day I came across some interesting letters written in the early seventies about the original demarcation of the reserved forests in my division.

In 1873 Mr. R—, District Officer, was ordered to adjust the forest boundaries and to complete settlement records with the help of Mr. B—, the Forest Officer. His final report was dated 15th September 1873 and is on my file. Naturally it is very interesting to me but whether it will be equally so to other readers of the *Indian Forester* I do not know. However I will take the risk of quoting some extracts.

"In accordance with these instructions Mr. B—, the Forest Officer of J— met me at K— on 6th May. We started next day and went steadily through the pergannah, examined every piece of forest land that had been left out, and completed the work on the 20th June."

This in itself was marvellous when one considers the nature of the country. They were giants in those days! Nevertheless Mr. R— is quite apologetic, for he goes on :—

"It may perhaps be thought that we took a very long time, but it must be borne in mind that in the greater part of the country we had to go through, there were no roads. We had to walk every inch of the way, and had daily to ascend and descend between two thousand and eleven thousand feet. People who have been accustomed to settlement work in the plains or in hills that are either intersected by roads, or are of themselves round and of an easy gradient, can form no idea of the labour we had to go through. Had it not been for the intimate knowledge of locality possessed by Mr. B— we should have been *even longer* than we were."

The italics are mine.

"We felt the want of a map very much.........we, however did everything in our power to make our work practically correct."

Dear old R—! It is difficult to imagine the present generation of District Officers taking all this trouble, even if they had the time to devote to it, which they have not.

"The Syanahs* of the khutts were always with us when we were inspecting their khutts, and some of the most influential Syanahs accompanied us throughout."

I should indeed think so! They must have regarded with fear and trembling this unwanted incursion into their territory.

"They were all encouraged to speak out freely, and in cases of doubt we discussed the matter at length."

Picture it! The wretched Syanahs gesticulating wildly and the phlegmatic Englishman calmly smoking his pipe!

"The Syanahs urged everything they could against land being taken up and Mr. B— urged the points in favour of it, and I then decided."

Mr. B— seems lucky to have escaped with his life!

"I have always endeavoured to err on the side of liberality and have invariably in cases where I had any real doubt about expediency of giving up or retaining lands, decided in favour of the villagers.

"In only one or two instances have the Syanahs of the khutts from which land was taken assented to the justice of it, but in very many have the Syanahs who accompanied me agreed that it was quite just and fair."

This was too much for me. I slid off my chair and subsided into a heap on the floor. After five minutes paralysis I climbed on to my seat and read on.

"During my whole tour I kept in view the idea of European settlers, either tea-planters or others, I however saw no open

A Syanah is the headman of the group of villages. The latter is known as Khat, modern spelling.

unoccupied lands which would be worth the while of any man of capital to take up."

Oh Capital! what sins have been committed in thy name! This should be read before the Fabian Society as an illustration of the economic principles actuating a capitalist regime pledged to lift up subject population from ignorance and idolatry!

"Every spring, every streamlet and every pond has already been taken advantage of by the native cultivators."

Selfish wretches!

"I saw some places within forest bounds where the land was splendid, where the climate must be perfect, and where the work of breaking up and cultivating would be quite easy, but there was no water. If tea or mulberry trees could be carried through the first three years, then I have little doubt but that they would grow luxuriantly, but I much fear these first three years could not be got over."

Mr. R— now becomes an enthusiastic nature worshipper almost an artist or a poet.

"At the same time, the position of some of these places is so beautiful, surrounded by the most magnificent scenery, with splendid specimens of forest trees on all sides and surrounded by wild flowers and ferns of every description, that I can well imagine a true lover of nature being contented to take up his abode there for ever, could he but scrape together the bare necessaries of life."

That must have been after a particularly strenuous climb!

"Having been so long in undisturbed possession, the villagers began erroneously to look upon the forest lands as their own and now try to persuade themselves that Government has acted harshly towards them."

Evidently seeing the futility of trying to persuade Mr. R— as well! In his eagerness Mr. R— exposes himself to the risk of a libel action for he continues.—

"To persons who are unacquainted with the facts of the case they do not attempt to set up any such claim or grievance but

they have a number of stock arguments which they pour into the ear of any new comer, and which, if he be like our late visitor, Captain M—, utterly ignorant of the circumstances and ready to believe in any grievance against the Local Government without taking the trouble to make enquiry from the local officers, would sound very plausible, and might in the absence of local officers, well acquainted with the previous history of the case, give a good deal of unnecessary trouble."

The only local officer available for consultation was the inimitable Mr. B— whom he had at his elbow all the time! Oh, Mr. B— I fear you are condemned to simmer in the bottomless cauldron unless old age has humanised you!

"Once or twice everything seemed amicably arranged, and the Syanahs made up their minds to sign, but again something put them off. I observed that whenever we were near C— they seemed more cantankerous and litigious. There was evidently some influence at work there."

Captain M-- perhaps.

"They at first were in the habit of holding out a threat of running away. They said the assessment was too high and their jungle was taken away, and so they would not stay, but would run off to Garhwal or Nahun, etc. I told them they were at perfect liberty to run away, but if they did they would never be allowed to come back again. They would then become very penitent and want to sign at once; in fact behaved just like foolish children.........

"It takes a great deal to make a hill man move. A man in the plains when he makes a little money as a rule lays it out in jewellery for his wives and children, which he can carry about with him. A hill man lays it out in a house. From the severity of the weather, hill men have of necessity to build good houses, but they go beyond this and lay out a lot of money on two or three storied houses when one storey would suffice."

Rot! They live in the top storey, keep their sheep and goats in the first and their cattle on the ground floor.

"They also have their door posts and lintels elaborately carved and cut, where plain work would do just as well."

Oh Mr. R—, where is your artistic sense? Can it only be evoked by fatigue or was that a mere flash in the pan?

The above quotations and my somewhat facetious comments on them are an excellent example of the well-known method, so beloved of politicians and journalists, of misrepresenting a man's character and motives by divorcing from the context the vulnerable parts of a speech or report.

By the above method it would be just as easy to make out a good case in defense of Mr. R— as against him. As a matter of fact he must have been an officer of more than usual kindness and sympathy, as is shown by the following extract from the end of his report.

"There is only one more matter which I would again urgently bring forward—that is, the appointment of the Divisional Forest Officer in J—. As I pointed out in former years, in the whole of B— and K—, and in the upper khutts of J—, the Government forests and the village lands are so intermixed that the Divisional Forest Officer must always be the leading power, and in his hands the weal or woe of the people in a great measure rests. If he is a hot tempered man, without patience to their childish, often frivolous complaints, and if he considers that the sole duty of Government is to grow deodar trees and maintain fire-lines, then people must suffer. If, on the other hand, he is a patient, good-tempered man, who has sympathy with the people and understands the Government has a duty to perform by them, the people will be happy. There is no reason whatever why the interests of Government should suffer because the interests of the people are kept in view."

Hats off to Mr. R—! There ought to be more like him.

D. F. O.

of the province is enormous. A few months ago a road-side *sissoo* tree at Gauhati about 65 years old fetched Rs. 150. The other day a *sissoo* about 60 years old fetched Rs. 100 at the Head-quarters station of Darrang District. Is not this a fair indication that it would be worth paying more attention to making *sissoo* plantations, and afforesting the accessible grassy blanks of Reserves,—which unfortunately are too many in this District—instead of trying with species of doubtful or less marketable value ?

A. K. ADHIKARI, P.F.S.,

Tezpur, Assam.

REVIEWS AND EXTRACTS.

THE EDINBURGH UNIVERSITY FORESTRY SOCIETY.

The fourth number of *Sylva*, the annual publication of the Edinburgh University Forestry Society contains articles and letters from foresters from various parts of the Empire, *e.g.*, "Problems of Forest Conservancy in the Gold Coast," by D. Hendry; "Counter Erosion Work in the Punjab," by Macwagon; "The effect of Fire on Regeneration," by H. S. D.: "The Submerged Forest on the Coast of Lincolnshire," by N. S. Stevenson. R. C. Fisher writes on "Forest Entomology in Britain." George W. Somerville deals with minor products under the title of "The Forest Medicine Chest." M. H. S. contributes "Some Notes on Artificial Seasoning of Timber," and H. M. Steven an appreciation of Archibald Menzies and David Douglas. Accounts are given of "The Advanced Course in France, 1923," "Cours pratique en France après le diplôme" and the "Practical Course, Dunkeld."

Under the pertinent question of "Where did that one go to, 'Erbert?" notes are given on the movements of Edinburgh Foresters.

THE EMPIRE FORESTRY ASSOCIATION.

The latest number of the *Empire Forestry Journal* (Vol. II, 2nd December 1923), is largely devoted to the Canadian Tour of the second Empire Forestry Conference, as may be gathered from the following articles: "Impressions of Canadian Forestry," by A. C. Forbes; "Silviculture in Canada," by C. D. Howe; "Forest Fires in Canada," by D. Roy Cameron; "Canadian Insect Problems," by J. W. Munro; "Softwood Resources of Canada," by R. D. Craig. A detailed account of the tour is provided by R. S. Troup.

The softwood resources of the United States are dealt with by W. D. Greeley, and those of Europe by Fraser Storey. W. A. Robertson describes India's foreign timber trade, and Sir James Calder deals with the timber trade of Europe. J. R. Ainslie makes suggestions for marketing tropical timbers. A review of Indian forest management is supplied by C. G. Trevor. Thomas Thomson gives an account of a Douglas fir plantation in Wales.

It will be remembered that at the conference it was resolved, that the *Empire Forestry Journal* should be the medium for the publication of official and technical information and that, pending the formation of an Empire Forestry Bureau, this information should be prepared by the standing Committee on Empire Forestry assisted by technical correspondents in all the Forest Departments of the Empire.

We understand that professional foresters may become members of the Association at a reduced rate of subscription, which will entitle them, among other privileges, to receive this valuable Journal regularly.

REAFFORESTATION IN CHINA.

There is no substitute for forestry as a factor in the permanent prevention of famines in China. The reforestation of her millions of unwooded acres alone will not prevent famines, but there can be no permanent prevention without it.

China's forests are spent, her hills are denuded, an adequate supply of forest products is lacking. Modes of living have had to be adjusted. Her agriculture has been forced to assume responsibility for furnishing fuel to her population, in addition to food and clothing, making impossible the replenishment of the supply of organic matter in the soil. Fertility and production have been lowered.

The season's rainfall has been dissipated in riotous run-offs, causing ruinous floods. Stream beds on one hand are all but dried up, there being little or no supply of ground water to replenish them by slow regular seepage, while other streams are silted up, unable to carry off the load of soil that has been brought to them from the barren, unproductive hills. Destruction of life and property, and untold suffering have resulted. "Beware of mountain water" read signs in many canyons in China, posted as a warning to travellers against the sudden rise of torrents during storms. Agriculture for many has become an all too hazardous occupation.

The people are affected not only economically, their productive efficiency being lessened, but they have suffered physically and socially as well, where their forests are gone.

After centuries of neglect, China last year spent about $250,000 in forestry work—planted about 1,000 nurseries, reforested about 100,000 acres of otherwise useless land and, produced about 100,000,000 young trees. About one-quarter of her 1,800 districts have forest nurseries for the upkeep of which they are taxed. Several of the provinces have developed Provincial Forest Services. Arbor Day is increasing in popularity, and its observance is being greatly extended each year. Forestry education is being rapidly developed, until there are now not only forestry schools, but forestry is taught in many of the secondary, particularly the agricultural schools.

These facts indicate clearly that China is making progress in her forestry development, that she is beginning to appreciate the need of reforestation and the relation of forests and forest

products to her national life.—[*Prof. John H. Reisner, University of Nanking* in *the Australian Forestry Journal, June 1923.*]

DURABILITY OF TEAK.

At the Bombay Engineering Congress Mr. Wright produced pieces of teak from Bijapur at least 370 years old, which he had tested for transverse strength. In the well-known formula $P = \frac{W \times L}{B + D^2}$, the value of P in the case of modern teak varies from 467 to 953, and 600 is a normal figure. Mr Wright found that his old specimens of teak, light in weight by age, had a $P = 875$, showing how little time had affected its strength. But 370 years are nothing for teak in favourable conditions. Dr. A. H. Sayce, the Assyriologist, records beams of teak, still undecayed, at Ctesiphon, dating from the sixth century, and in India the teak ribs of the Buddhist *datiya* at Karli may possibly date from some years B. C.—[*Indian Engineering, December 29th, 1923.*]

COUNTER-EROSION WORK IN THE PUNJAB.

Of the many queer tracts of country which man in his temerity has tackled under schemes of reclamation, perhaps the most uncouth and unprofitable are the Pabbi Hills, which form an extension of the Himalayan foothills out into the flat expanse of the Punjab plain. The main ridge of these hills, whose highest points are some 1,300 feet above sea level and 600 feet above the neighbouring plains, runs for about 20 miles parallel with the Jhelum from the point where that mighty stream emerges from the real foothills of the Himalaya.

"Pabbi" is actually the Punjabi for any high, broken ground and certainly it would be difficult to imagine anything more derelict than this geological rubbish-dump with its tumbled ravines of bare earth. The railway line and the Grand Trunk Road from Lahore to Rawalpindi cross the range, and the traveller gets a view of rugged slopes clothed scantily with thorny *phulai* scrub, with here and there a cliff of bare rock or a steep scree of loose red

clay-shale. But both the road and the railway run through the reclamation area where work was started forty years ago by the Forest Service, and one has to climb up to a higher view-point to appreciate the comparative greenness and solidarity of the old "plantation area" compared with the devastation of the unclaimed ravines. It requires no impressionist to realise that this part of the world has "gone bad," and that the whole range is being carved out afresh and washed away by each monsoon deluge.

Originally, as far as one can judge, the range was a continuous undulating plateau of savannah or forest land formed geologically by a slight synclinal fold in the carboniferous sandstone series which immediately underlies most of the alluvial plains of the Punjab. In this fold the sandstone has been raised some hundreds of feet above the present level of the plains, and with the natural processes of erosion the upper layer of soft and friable stone has been partly worn away. Beneath it lay a much more vulnerable series of clay shales and sand, and wherever these were exposed, undercutting and ravining set in, until the whole area is now a series of islands of the original plateau separated by deep gorges and linked up by incongruously carved and top-heavy ridges of disintegrated rock. The rainfall average is about 25 inches but more than half of this falls in a few hours during the torrential monsoon storms of July and August, when literally millions of tons of sterile silt are washed down on to the zamindari fields below. The chief danger lies in the fact that the Upper Jhelum Canal skirts the base of the range, and throughout the twenty miles, each torrent which flows towards the Jhelum River has to find a passage under the canal bed through a masonry "syphon" tunnel. The canal was built in 1912—15 as part of the magnificent Triple Project for pooling the available water of the three great rivers, the Jhelum, the Chenab and the Ravi, to supply the various canal colonies. So far, the engineers' calculations for these torrent escapes have proved adequate, but the erosion in the unreclaimed areas is annually getting worse, and if a single syphon were to become choked, the arrested torrent would almost certainly force a breach in the bank with consequences that would spell disaster and suffering for the canal colony away to the southward. To the

east, on the Chenab side, many of the torrent beds, which during most of the year are dry wastes of sterile sand between the fields, peter out before they reach the river, for the water is trapped by the cultivators by making earth "*bands*." In many cases the silt has appreciably reduced the fertility of the soil, and in others the actual ravining processes are spreading out into the plains and many fields have been rendered useless for ploughing.

The history of the counter-erosion work is available in the old Range Journal, which contains everything from the strafes of visiting conservators, including a visit from the redoubtable Ribbentrop when he was I.G.F., to a wordy warfare in multi-coloured inks between a verbose ranger and an equally incompetent D.F.O., whose pen was much more active than his feet! For anyone who has been caught by the fascination of the loneliness of this No Man's Land with its gaunt ravines and uncouth earth carvings, the Journal makes most interesting reading. The continuity of the scheme of work was occasionally broken, such as when a conservator came to the conclusion that the Pabbi could very well look after itself and proceeded to allow it to do so for an interval of years. During most of the time, however, experiments with new tree species were going forward, and out of more then forty species which have been tried, only two could be called reliable in this inhospitable region. Of these, the *phulai* (*Acacia modesta*) is of desperately slow growth, reaching a height of 14 feet and a diameter of 3 inches in thirty years, after which it dies off—and *walaiti jand* (*Prosopis glandulosa*) which grows slightly quicker, but which is hardly saleable even as fire wood. Some of the better timber species such as *shisham* and *kikar* have done quite well in the ravine bottoms, where they got a certain amount of shelter and moisture.

Of the various methods which have been used for checking the erosion the original scheme of building low "dry stane dikes" across the V of the ravine channels and along the foot of unanchored screes, has proved the most useful. The value of these walls can easily be seen to-day where subsequent erosion all around has isolated them and their load of earth. Now, of course, the cost of daily labour is three or four times what it was when

these walls were built, and at the moment the "economists" among the Indian politicians are so active that it is impossible to get large sanctions to extend the reclamation area. Within the last three years, however, some fresh work has been started, the main scheme of which is to waylay the silt building very solid earth "*bands*" or embankments across the ravines, thus stopping the rush of water and allowing it to drain off through a side escape. The water dumps its load of silt in the "tank" thus formed which fills up gradually with silt. Enough water is held back to form a reserve of moisture which enables many tree species to prosper on these *bands* which would not even germinate under the ordinary dry conditions of the area. The ravine bottoms are being sown with shisham and the plateau tops are being ploughed up between the existing rows of *phulai* and *Prosopis* in order to reduce the run-off and improve the grass growth. "Contour trenching" is also being carried out on all the less precipitous ravined slopes; lengths of a few feet are dug out and seed is sown along the berm, thus a small reserve of moisture is held back for the plant when it germinates in the rainy season and the precipitate rush of the surface drainage is checked to some extent by the trenches.

During the drought years of 1920-21, the whole area was opened for grazing, and it is as a fodder reserve for bad years that the Pabbi must be treated from the point of view of forest policy. It is not so much in the production of timber as in the reclamation of larger areas for a fodder reserve that our hopes of future usefulness lie, and if the Forest Department were given sufficient scope, the remainder of this unprofitable wilderness and many similar waste areas in the Province could be made to form a spendid reserve against the "lean years" which periodically bring so much hardship to the agricultural districts.—[*Macwagon in Sylva, No. 4, 1923.*]

JAVANESE TEAK.

The Amsterdam correspondent of the *Manchester Guardian*, in a report on the Dutch East Indies, states that the number

of large enterprises in which both private and Government capital participates is increasing in the Netherlands Indies. Since the establishment of the Nederl.-Ind. Aardolie Mij. (Dutch East Indian Petroleum Co.) for the exploitation of the Djambi fields, in which the Royal Dutch and the Government are interested, the plan for the erection of a blast furnace enterprise with the participation of the Government has now been accepted by the Indian National Council.

It is very probable adds the correspondent, that a similar collaboration will come about in the timber trade. The National Council has given its consent to such a scheme. It is noteworthy that this latter scheme does not emanate from the Government but from private quarters.

Owing to the fluctuating prices and the unfavourable conditions of the market, the big "*djati*" (Java-teak) enterprises have been unable to make their businesses pay during the past few years, while the Government instead of having 200,000 cubic metres of timber cut in its forests as in normal years, had in 1923 only 75,000 cubic metres cut. The Government is to secure participation in the capital of several timber trade enterprises by obtaining preference shares, not, however for cash, but as a partial return service for the contracts concluded with the various concerns. To these the timber (up to 30 per cent. of the total yield of the Government's forests) is ceded at a very low price.—[*Timber Trades Journal, Vol. XOV, No. 2473.*]

THE AERIAL SURVEY OF THE IRRAWADDY DELTA FORESTS.

The success of the aerial survey of the Irrawaddy Delta carried out by Mr. Kemp and the officers under him may be gathered from the fact that whereas it was originally intended that only 1,000 square miles should be surveyed, it has now been decided to extend the area to 1,350 square miles. The achievement is the more remarkable because many difficulties had to be overcome, not the least of them being the late arrival of

supplies and the conversion of the two D. H. 9 machines into seaplanes, fitted with floats specially designed by Mr. Kemp for their work. As a matter of fact practically only one of these machines has been used, and it has flown 110 hours, representing a distance of about 10,000 miles, during which 3,000 plates have been exposed. The photographs are said to have shown a high percentage of accuracy, with little or no variation of scale throughout the whole area, and the detail is so exactly reproduced that the Forest Department are believed to be considering the possibility of counting individual khanzo trees—a larger type of tree abundant in the delta—by means of the photographs. Mechanical troubles have been comparatively few, the chief of them being the failure of the magneto occasionally owing to "the shellac melting on the armature and throwing itself off until it caused the whole to seize up between the poles" Mr. Kemp carried out all the test flights, but the actual piloting has been performed by Major Cochran-Patrick. The photographic work has been in the charge of Flying Officer Durward, who has had considerable experience in India and Iraq, and whose service have been lent to the survey by the Royal Air Force.—[*The Pioneer 12th April 1924.*]

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WHAT IS *THE* LAC INSECT?

The question whether the production of commercial lac is due to several species of *Coccidæ*, or to many varieties or strains of a single species, is one that has remained unattended until quite recently. Although the problem has long been investigated by specialists, it is only within the past two years that the results of their labours have been published. It is the object of this article to draw attention to some notable contributions to the subject.

E. E. Green completed the fifth volume of the "Coccidæ of Ceylon" in 1922, and thereby provided one of the best existing accounts of the group as found in Ceylon. J. C. Chamberlin published a "Systematic Monograph of the Tachardiinæ or Lac Insects" in October, 1923 (*Bull. Ent. Research, XVI (2), pages* 147—212) in which the lac insects of the world are exhaustively treated. S. Mahdihassan, approaching the subject from another aspect, produced in the same year a paper on the "Classification of Lac Insects from a Physiological Stand Point", (Journ. Sci. Assoc., Maharajah's College, Vizianagaram, I (2, 3) pages 47—99). A paper by the same author on the life-cycle of south Indian Lac insects appeared in the *Indian Forester* for December 1923, pages 653—663. The Agricultural Research Institute, Pusa, has issued a thoroughly revised edition of its Bulletin on the cultivation of lac in the plains of India by C. S. Misra (Bull. 142, 1923). And lastly T. D. A. Cockerell proposed further changes in nomenclature in February, 1924 (Psyche, XXXI (1), pages 47—48).

The term "lac insect" is extended to include those scale insects (*Coccidæ*) that produce a hard, more or less resinous secretion, soluble in alcohol, which completely envelopes them in the form of separate cells or of a continuous incrustation. They are grouped together into a sub-family, the *Tachardiinæ*. It has been shown as a result of chemical analysis that the lac secreted by the American genus *Tachardiella* is almost identical in composition to that of the Oriental *Tachardia*. And while an analysis has never been made of the lac of *Austrotachardia*, in all respects it seems to behave as a true lac. The tests of the Oriental genus *Tachardina* on the other hand are of a hard substance resembling gutta-percha (Chamberlin).

Mahdihassan attempts to answer the question "What is meant by Lac"? and comes to the conclusion that the Indian forms may be assigned to two groups, the true lac insects (to which he gives the name *Lakshadia*), and the pseudo-lac insects (to which the name *Tachardia* is restricted). True lac insects produce a secretion with resinous properties, which melts with heat and may be drawn into a thread, and with alcohol forms a viscous varnish. The pseudo-lac insects produce a secretion like hardened gelatine rather than a brittle resin, which melts like butter with heat and does not draw into threads; with alcohol the substance swells up leaving a large insoluble residue. There are also morphological differences. While his separation of the two groups is practical, the names proposed by Mahdihassan cannot be adopted, as *Lakshadia* automatically falls as a synonym to the older *Tachardia* (being based on *Tachardia lacca* or new species congeneric with it); and *Tachardia* as applied to the pseudo-lac insects is congeneric with *Tachardina*.

Disregarding the pseudo-lac insects we may now consider more closely the true lac-producing forms.

Tachardia albizziæ, according to Green, produces a lac which is the principal material employed in the lac industry of Ceylon.

T. (Metatachardia) conchiferata, known only in Ceylon, where it is less abundant than *T. albizziæ*, but produces a much superior lac.

The species of lac insects found in India are given in the annexed table, which correlates the opinions of the authors mentioned above as to the specific and generic limits of the forms:—

THE INDIAN SPECIES OF LAC INSECTS.

Green, 1922.	Chamberlin, 1923.	Mahdihassan, 1923.	Cockerell, 1924.
Tachardia albizziæ Green =	*Tachardia albizziæ* Green =	*Lakshadia albizziæ* Green =	*Laccifer albizziæ* Green.
(,, *fici* Green) =	,, *fici* Green =	,, *ficii* (*sic*) Green =	,, *fici* Green.
	,, *ebrachiata* Chamb. =	... ... =	,, *ebrachiatus* Chamb.
,, *lacca* Kerr =	,, *lacca* Kerr. =	*Lakshadia indica* Mahdihassan ,, *nagoliensis* ,, ,, *sindica* ,, ,, *chinensis* ,, ,, *mysorensis* ,, ,, *communis* ,,	= ,, *lacca* Kerr.
,, *conchiferata* Green	*Metatachardia conchiferata* Green =	... ... =	,, *conchiferatus* Green.
	Tachardina ternata Chamb. =	... ... =	(*Tachardina ternata* Chamb.)
Tachardia minuta Green (nec Morrison) =	,, *lobata* Chamb. =	*Tachardia minuta* .. = (nec Morrison)	,, *lobata* Green.
		,, *silvestrii* ,,	

Tachardia fici, known only from Monghyr in India, gives a pale lemon-yellow lac like that on *Butea frondosa*; the colour of the alcoholic solution is also similar.

Tachardia ebrachiata, according to Chamberlin, forms a lac that is very much lighter in colour than that of *lacca*, being a clear reddish-orange.

The insect described by Kerr in 1782 as *(Coccus) lacca* has always been regarded as scource of the commercial product known as shellac, and it will be seen from the table that Green and Chamberlin agree in regarding *lacca* as one homogenous species in which they are supported by Misra, Cockerell and many others, whereas Mahdihassan splits it up into at least six species.* Green holds the more conservative opinion as to the morphological variability possible within the limits of the species *lacca*. He considers it a peculiarly polymorphic species, of which the extreme forms might well be regarded as species, if the connecting links were unknown, and is inclined to rank his *Tachardia fici* as merely an extreme form of *lacca*. Chamberlin, on the other hand, maintains *fici* as a distinct species and further-more separates from *lacca* the closely-related *ebrachiata* on well marked characters. Mahdihassan considers that morphological characters alone are insufficient for the classification of lac insects, and maintains the physiological standpoint should be taken, as these two aspects of the study are mutually dependent. From a study of the micro-organisms associated with lac insects; the appearance, composition, solubility and amount of the lac secreted; the food-plants; the number of broods, etc., he considers that there are in India eight forms of true lac-producing insects, that deserve specific rank. For six of these he proposes new names, *viz.*, *indica*, *nagoliensis*, *sindica*, *chinensis*, *mysorensis*, *communis*. Unfortunately these names are not accompained by any recognisable morphological description, and are therefore *nomina nuda*, or names of no account in entomology. To the cultivator of lac, however, they have at least a value as indications of definite forms or strains of the commercial lac insect *Tachardia lacca*.

* In 1919 Misra was of opinion that there are a number of species of lac-insect and of which *T. lacca* is one (Proc. Third Ent. Meetin Pusa 1919, II, p. 799.

They are recognisable by the following characters:—

1. '*Indica*".—A lemon-yellow lac on *Butea frondosa*, only likely to be mistaken for that on *Schleichera trijuga.* Alcoholic solution lemon-yellow.
2. "*Nagoliensis*".—A thick lemon-yellow lac on *Schleichera trijuga* with a slightly opaque lemon-yellow solution in alcohol.
3. "*Sindica* ".—A distinctly yellow lac on *Acacia arabica* in Sind.
4. "*Chinensis* ".—A dark or yellowish-chestnut lac found in Assam, Indo-China, and possibly Burma and S. China.
5. "*Mysorensis* ".—A still darker or yellowish-chestnut lac on *Shorea Talura* in Mysore that grows well on *Nephelium Litchi.* The insect is the smallest of all forms and is trivoltine.
6. "*Communis*".—The darkest lac, chestnut, garnet or ruby coloured on *Ficus mysorensis, F. bengalensis, F. religiosa. F. Bengamina* and on *Albizzia Lebbek* in various parts of India ; also grows well on numerous other trees. Alcoholic solution is tea-coloured.

These grades of colour among stick-lac have been more or less clearly recognised for ages, and have given rise to much speculation as their conspecific identity. Beyond speculation the matter has not progressed. At the Agricultural Research Institute, Pusa, is a collection of different grades of cultivated and wild lac, wet and dry, that has been made from all lac-producing areas in collaboration with forest officers, but it still awaits working up. At the Forest Research Institute no research on the lac insect has been done since 1912. The studies of Imms and Chatterjee published in 1915 (Ind. For. Mem., III, I) were confined to the biology and natural enemies of *Butea* lac only.

It is evident that experiments of a very simple nature could determine if the various grades of stick-lac are due primarily to the host-tree or to the insect, and if the characters are stable and transferable from one species of tree to another. Mahdihassan points out that the colour of the gum or sap of the host-tree does not necessarily influence the colour of lac. The darkest lac occurs

on species of *Ficus*, which have a white latex ; the next darkest lac occurs on *Shorea Talura*, that has a glassy white resin.

Cross-inoculation, as a test for the stability of characters or powers of adaptation, has been relatively neglected by investigators. For example, it is generally believed that when lac from *S. trijuga* is transferred to *B. frondosa*, the first crop resembles that of the parental lac, and the subsequent generations gradually take on the character of *Butea* lac. As Mahdihassan points out, if the belief cited is a fact, then both *Schleichera* and *Butea* forms must be regarded as belonging to one species with great powers of variation due to nutrition; but as the *Butea* insect does not establish successfully on *Schleichera* it must be credited only with powers of degenerative adaptability. Using the same line of argument, he considers wild lac on *Shorea Talura*, *Ficus mysorensis*, *Pongamia glabra*, and *Ixora parviflora* to be formed by four distinct species, because they show no degeneration or approach to one another in morphological or physiological characters, when grown on a common host-plant. The peculiarity of the trivoltine lac insect on *Shorea Talura* (*i.e.*, three crops in 13 lunar months) has been successfully transferred to two other host-trees, *Butea frondosa* and *Acacia Farnesiana*.

Host-selection or preference for a particular form of food is not peculiar to the Coccidæ. Other insects with polyphagous habits as far as the species is concerned, develop strains or varieties, which, by continual breeding on one host-plant, become restricted to that host entirely or transfer to another only with difficulty. It may be said that from the economic aspect of the problem, the lac-cultivator in not assisted greatly by the knowledge that *Tachardia lacca* is on the one hand a single species, or is on the other hand a group of morphologically similar species. However, in regarding it as one species he will be supported by the majority.

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THE ANTISEPTIC TREATMENT OF TIMBER IN INDIA.

Timber is so well-known to most people that very few ever realise how important it is, and what a tremendous part it really plays in the world's affairs. Still less do they realise the amount of labour and thought entailed in bringing it into the form in which they are familiar with it.

So casually is it regarded by the average individual, that the thought of conserving the supply, or economically utilising that which is at his disposal, does not occur to him spontaneously, but is generally borne in upon him by some outside agency.

Economic pressure since the Great War has become so acute in most parts of the world, that we are now realising more than ever, that our resources must be put to the best economic use, and the problem of the prolongation of the life of timber has become even more pressing,—its solution more urgent.

This problem is not by any means a new one for the art of preserving timber from decay was known to the Ancient Greeks and the Early Egyptians more than 3,000 years ago.

Throughout the ages numerous devices have been brought into use to obtain the desired effect, and the number of patents taken out within the last 30 years covering solutions and devices for preserving timber is legion.

Of those preservatives which have stood the test of time the following are the most important: (1) Creosote, (2) Zinc Chloride (Burnettising), (3) Copper Sulphate and (4) Arsenic and Sugar Solution (Powellising).

(1) *Creosote.*—The name Creosote was originally given to the heavy distillate derived from the distillation of Wood Tar, and was used by Moll as far back as 1835 for the preservation of timber. The use of this substance however has been dropped in more recent times, and the word Creosote is now more popularly applied to the oil obtained from Coal Tar.

It is one of the best and most efficient antiseptics for Wood Preservation known, but is unfortunately rather expensive.

Its use mixed with heavy Petroleum or Residue Oil is now, however, becoming popular and is a better economic proposition.

(2) *Zinc Chloride* is a powerful antiseptic and has given very good results in Europe and America, when used in comparatively dry areas. It suffers from the disadvantage of being soluble in water and hence becomes washed out of timber in wet localities.

(3) *Copper Sulphate* is dearer than Zinc Chloride and also suffers from the disadvantage of being very soluble in water. Although still used in Europe it is gradually dropping out of use.

(4) *Arsenic and Sugar Solution*, a comparatively modern innovation has undoubtedly given excellent service in this country and Australia; it has the great advantage of being relatively cheap.

Considering the wealth of timber in the forests of India and the growing demand for it in the country, coupled with the fact that many timbers are readily attacked by white ants, it is not surprising that efforts are being made to gather data concerning their durability after treatment for the purpose of railway sleepers.

If the whole of the railway track in India were laid on wooden sleepers, many hundreds of thousands of sleepers would be required annually for the purpose of replacements. As it is over 4,200,000 wooden sleepers are purchased annually, which are naturally durable and give from 15 to 20 years' service, and as considerably larger quantities are required the present supply of durable sleepers is not sufficiently great nor is their cost sufficiently low to warrant their exclusive use.

It is therefore apparent that some effort must be made to utilise the naturally non-durable timbers by subjecting them to some process, which will prolong their life and at the same time be economically sound.

This problem in utilisation has also a bearing on silviculture for if the so-called "Jungle woods" which are at present not utilised can be made valuable for the purpose of railway construction or other purposes, their removal from the forests to make room for more valuable species will more than pay for itself.

With this end in view experiments were undertaken by the Forest Economist about twelve years ago to determine whether

a few selected species which are naturally not durable, could be brought into use. The progress of these experiments was recorded in Indian Forest Records and brought up to date in Forest Bulletin No. 53 of 1923, and has amply demonstrated that all the species treated can be readily utilised.

To give one instance *Terminalia tomentosa* or *sain*, a very hard wood, and eminently suitable for sleeper purposes on that account, which untreated only lasts about five years, gives a life of more than twelve years when subjected to a preservative process at an additional cost of about 25 per cent. of its original value.

The species originally treated were few in number and were mostly treated by soaking the timbers in an open tank containing the preservative. It is now proposed to experiment on more than fifty different species by treating them with different antiseptics under pressure.

From the result of past experiments it would appear that the most likely antiseptics for use in India are (1) Creosote mixed with residue or fuel oil and (2) Powellising solution, and these will be the chief preservatives used.

The plant in which the experiments will be carried out consists essentially of a cylinder closed at one end and having a door at the other. This door when closed is clamped in position and renders the cylinder water-or oil-tight under a working pressure of 180 lbs. per sq. in. The cylinder is capable of withstanding a working pressure of 200 lbs. per sq. in. and has been tested to 300 lbs. per sq. in.

Below the cylinder is the service tank which holds the supply of antiseptic, which is to be forced into the wood and on the same level as the Pressure Cylinder are two cylindrical storage-tanks containing the reserved supply of preservatives.

The plant is fitted with a hydraulic pressure-pump and an air-pump worked off the same shaft by means of an electric motor. The hydraulic pump pumps the antiseptic into the cylinder when the timber is in position and puts on the pressure to force the preservative into the wood. The air pump is so arranged that

it can create a vacuum inside the cylinder or compress the air inside it.

In addition also there is an elevated tank capable of withstanding 100 lbs. pressure for use with the Rueping Process.

There are four main processes employed for impregnating timber under pressure (1) Full Cell, (2) Lowry or Empty Cell, (3) Rueping, (4) Boiling in.

In the *Full Cell Process* after the wood has been put in position in the cylinder a vacuum of about 20" is drawn inside the cylinder and kept up for about ¾ hour. Without breaking the vacuum, oil is allowed to enter the cylinder from the service tank until the cylinder is full. The vacuum is then broken and oil allowed to run into the wood to fill the cells which have been evacuated of air. The cylinder is then filled by means of the pump and entirely closed. More oil is afterwards forced in by means of the pressure pump. Obviously, if the antiseptic is forced in at a greater rate than the wood can absorb it, the pressure will rise accordingly. The rate of forcing in antiseptic is thus regulated so that the pressure builds up slowly. When sufficient preservative has entered the wood, as calculated from measurements on the service tank, the pressure is released and the antiseptic returned to the service tank. A final vacuum is then applied to remove surplus preservative from the surface of the timber and the process is complete.

In the *Lowry Process* no initial vacuum is applied but the cylinder is filled with antiseptic fluid after the wood has been put in position and the cylinder closed. A further supply is forced in under pressure as before and when sufficient fluid has been injected the pressure is released and the fluid returned to the service tank. A final vacuum of about 20" is then applied for about ¾ hour, when the air in the cells is withdrawn bringing antiseptic with it. The cell walls are thus left with a preservative coating but the cells themselves are not left full of antiseptic as in the Full Cell Process.

In the *Rueping Process* an overhead pressure tank is necessary. This overhead tank contains the preservative liquid, and air-

pressure is built up both in the overhead tank and in the cylinder where the wood is in position. The oil is then run into the cylinder by gravity without releasing the air-pressure, the air being transferred to the overhead tank at the same time. The cylinder is then closed and pressure applied as in the other processes. When the impregnation is sufficient the pressure is released; the air under pressure in the cells being released and so forcing out surplus fluid.

In addition a vacuum is applied which has the effect of further emptying the cells. They are thus left much freer of antiseptic than in the previous processes.

In the *Boiling Process* the timber in the cylinder is covered with antiseptic and the whole heated by steam while a vacuum is applied. Moisture in the wood thus evaporates below its boiling point while no damage is done to the timber by overheating. After a more or less lengthy period of boiling which helps to season the timber the vacuum is broken and the process completed as in the Full Cell Process. According to the present programme of work it is proposed to determine for as many species of Indian timbers as possible the amount of preservative which can be got into them and to draw up specifications for their treatment. For this reason the plant to be used is capable of working all the best processes and is fitted with instruments for recording temperature, pressure and vacuum, wherever such data may prove useful.

It is anticipated that the present programme alone will take some years to carry out and when completed will provide exceedingly useful information for the railways and commercial firms generally who may be interested in the subject on a larger scale.

In addition investigations will be undertaken to answer enquiries which it is hoped will from time to time come from various sources.

The object of such experiments are twofold, namely, (1) more intensive utilisation of non-durable but otherwise strong serviceable timbers and (ii) to help to solve the problem of wooden Railway sleepers in India. The corollary to (i) is increased revenue to the State and permitting the adoption of more inten-

sive methods of management in our forests, and to (ii) the adoption of Indian as against imported sleeper woods by Indian Railways.

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THE TAUNGYA SYSTEM IN CACHAR DIVISION

THE TAUNGYA SYSTEM IN CACHAR DIVISION, ASSAM.

The introduction of artificial reproduction in this Division had been under consideration for some years. The existing type of forest,—mixed evergreen and bamboo,—yielding on an average approximately one mature tree per acre, is extensive in area and has yielded in the past a good revenue without much more outlay of expenditure other than that involved in the upkeep of revenue stations on river-banks. Continual skinning of the forest within easy elephant dragging-distance of the banks of rivers without any silvicultural improvement to the growing stock brought the Forest Department to realise that the previous state of affairs could not continue indefinitely, and that the ever-decreasing revenue must in course of time diminish to such an extent, that it would no longer pay to maintain a large staff of Forest Officers working only in revenue stations, merely to tax the timber trade. Accordingly in 1921 the present Conservator gave orders to start planting out teak under the taungya system. There were certain difficulties to contend with, namely, the lack of knowledge and the disinclination of subordinates, accustomed only to revenue station work, to turn out and tackle real forest work; the absence of suitable communications through the forests; and the natural suspicion with which jhuming hills-people view any innovation. This involved a good deal of extra trouble for the Divisional Officer, who had to supervise everything in person, and also to train his subordinates for the work. On the other hand, the land-hunger caused by the ever-increasing population of this district induced some of the local Cacharies, Kukies, Lushais and Tipperahs to accept

Fig. 1. A two-year old teak taungya with *Macaranga* sown between the lines: Cachar Division, Assam.

Fig. 2. A two-year old teak taungya: Cachar.

Fig. 3. A four-year old teak plantation Cachar.

Photos by C. J. Rowbotham, I.F.S.

the Forest Department's terms. In 1920, 5 acres were planted up with teak after cutting and burning the jungle, under the three methods, *i.e.*, root and shoot-pruning, planting entire with balls of earth, and without. The rapid growth of the teak under the first method, as compared with the other two, left no doubt as to the quickest way of raising the teak above the *Eupatorium* (Giant aggeratum), which in the last ten years has invaded and spread over the open waste spaces of this district.

In the year 1922-23 about three acres of *tillah* and low land at Loharbund, and six acres at Salgonga were jhumed by Tipperahs and Kukies for cultivation of *makai* (maize) and paddy. These areas were planted up 30′ × 8′ in May with teak seedlings which had been germinated from Burma teak seeds in the previous March, placing four seedlings 2 feet spare in a square at each stake, while the low land was planted up 30′ × 8′ with *jarul (Lagerstrœmia Flos-Reginæ)* after reaping their paddy early in the cold weather. The high ground was sown with cotton by the jhum cultivators. The placing of four seedlings at each stake gave excellent results, as it prevented the young teak from being overcrowded by the paddy. In March of the following year the jhumiahs continued their cultivation; *kachu* or ginger was put out, in addition to the cotton. Surplus teak plants at stake in the original 30 lines were utilised after being root and shoot-pruned to plant up intermediate lines 10′ apart. In places *Macaranga* seeds were sown between the lines of teak in the second year, and, as the accompanying photograph shows, the *Macaranga* is likely to be useful in preventing the incursion of *Eupatorium* and as a nurse for the teak. The average height of the teak after two years' growth was six feet, except where it was retarded by insufficient weeding by subordinates during the rains, and in many cases the height-growth was considerably more, reaching in some cases to eighteen feet, as shown in another photograph.

In the second year of taungya working, *i.e.*, 1923-24, all subordinates at revenue-stations were made to visit the taungya areas in turn for periods of several days during the planting and weeding season, while those regularly employed in Forest

Beats on taungyas and mixed species plantations had by this time acquired useful knowledge as regards the germination of teak, and the more important of the evergreen species, and plantation work, and in some cases showed commendable keenness for their work.

The lack of paths and roads in the forests of this district has been dealt with by settling a number of new forest villages in low-lying areas in the Reserve for doing earth-work, and every year several new forest villages of hillmen are being started, who, after being given time to build their houses and arclelowland for permanent cultivation, are employed for teak taungyas in accessible places near streams and rivers. In 1923-24 additional areas totalling 29 acres were brought under taungya cultivation, the spacing of plants being as before 30′ × 8′. The surplus teak plants from the nurseries of 1922-23 were utilised after being root and shoot-pruned ; unfortunately all the teak seeds sown in March 1923 turned out to be bad and failed to germinate. In some of the taungyas the original 30′ × ′8 lines had to be stocked with mixed species *jarul (Lagerstrœmia Flos-Reginæ)*, *cham (Artocarpus Chaplasha)*, *amari (Amoora spectabilis)* and *gurjan (Dipterocarpus turbinatus)*. For the coming year, 1924-25, some 56 acres for new taungyas have been cut and burnt. There has been a certain amount of friction with the jhum cultivators over the question of leaving sufficient space at stake to prevent the plants from being suppressed by the paddy in their first year, but it is hoped to meet this by postponing the planting up of intermediate lines between the 30′ line till the 3rd year, when the jhum cultivators abandon their jhums, but will give occasional assistance in weeding. Except in one taungya the number of casualties amongst teak has been very small, and all blanks have been filled up with stump-pruned mixed evergreen species.

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ACROSS THE PEGU-YOMAS WITH A CONSERVATOR.

It was on a cold night in the beginning of December, when we got down at the station at 3 o'clock in the morning shivering

to the very bone and shouting "Cooly ! Cooly !!" Immediately afterwards we lade our carts and proceeded into the forests for 14 miles wishing good-bye to the railway line at least for a period of one and a half months. Our hearts were already heavy at the very thought of this so-called short tour, but think of the weight when a month later, when a revised tour programme showed an extension for another month and a half. At least there were with us two novices in the art of going into the forests, and they were a cook and a peon. They were afraid and so I and my co-clerk. Everyday we thought of Rangoon and the days to be spent before we got back, and many a time we abandoned the thought of ever returning alive or healthy.

Everyday we used to see the same set of people, the same herd of elephants and their attendants, the same kinds of trees and most of all, the same high hills and mountain rills ; and we were tired of them all. Off and on we saw a Karen *Te* here, and a *taungya* there, and at the sight of this miniature village our hearts wore a little smile ; not that we saw a new set of people here but that there was a chance of ransacking the poor Karen's field of some vegetables. That was a grand day for us all to have dainty dishes of sour jungle-brinjals and tomatoes. But the hill-loving Karen has a large heart and very often he gave us some roots and cucumbers of his frugal store in spite of our open plunder with permission, on his limited cultivation.

One day we saw a herd of 15 or 16 wild elephants grazing carelessly and joyously on the old open *ponzos*, and it was a silent pleasure to watch them ; and no one knows where all the pleasure had gone when a huge tusker brushed past the thick bamboo undergrowth to our left, trampling and trundling heavily to the farther side. I can never forget the way my co-clerk ran for his life and got up-hill and the fright with which my peon and our guide the Forester who carried a gun and only a few minutes ago, boasted that he was a good shot, made for their lives. That mighty beast ! Had he only known that we were also as much afraid of our lives as he was of his ! That very day, our conservator

sorely missed a fine type of *saing* which was lazily chewing the cud in the sun. Surely, the place was a very paradise for game.

It is usual here as in every other place for all elephant attendants to fall ill at one and the same time when they get wind of a long tour, and no sooner than a week had elapsed, they started giving us trouble which lasted all through the tour. Our elephant Jemadar is a queer fellow ; he who is not even a wee-bit afraid of our dangerous brute Mido, one day actually got through the back staircase of a bungalow to see his Sahib and get orders for the morrow, for the simple reason that the Divisional Officer had a dog with him. He fears a dog as much as we are of elephants. Men differ in their mettle and I cannot say anything but simply laugh in my sleeves.

So far so good and we began the New Year with a fine leg of venison for our dinner. That unfortunate victim, the barking-deer was shot by a mahout who never missed a shot for he was a one-eyed man.

And while we made our best to forget our remaining days in the forests by keeping as cheerful as we could in spite of our hard days, one day it happened that we should do a hot, dry, stiff march of 13 miles across paddy fields and stubbles, and I was much disappointed in not being able to have a glass to quench my thirst though there were Indian (Ooriya and Bengali) villages almost all along the village. Here I had a new experience. I found myself an untouchable and had to drink my water " pariah-fashion ; " and still at the cost of wet sleeves I did drink. That day alone I dreaded my way back over the same grounds once again, which was to be after a week or so. During those days we had no daily marches to make over dales and hills ; but our ten days ' turn away from the routine of jungle life, resulted in—thanks for a conservator who awaited us in the forests—affording us a vigorous physical exercise of 21 miles per day across the same old parched up paddy fields where not a sheltering brook could be seen though we were said to be touring in the forests.

And we had to pitch three camps before we could be said to have got clear of the Pegu-Yomas. The first day we did the

toughest part of the ascent and we went up and up and up resting at stages of about 20 feet and our first day's camp in the hills was exactly at a place where our legs refused to carry us any further. And those poor intelligent creatures, the elephants, too had the same trouble perhaps, but they were used to it. And they were all dark camps with swampy grounds and a little water.

Of course, after spending full two and a half months in the forests we got back to our dear headquarters only to spend with redoubled speed, what we had been unable to squander in the forests, and once again to give ourselves up to all the frivolities and luxuries in Rangoon. The trials of a tour clerk are great, and though at times enjoyable, are yet detestable. But let him always hope for the best.

R. K.

THE LIABILITY OF DEODAR TO THE ATTACK OF *TRAMETES PINI* (BROT. FR.) IN LOLAB, KASHMIR.

In his comprehensive monograph on *Trametes Pini*, Mr. Hole gives a list of 35 conifers, which are attacked by this fungus in Europe, America and Japan. This list covers practically all the pines, many *Abies*, *Picea*, *Larix*, *Tsuga*, *Pseudotsuga* and other coniferous genera, and the only exception appears to be *Cedrus*. Referring to the liability of deodar to the attack of this fungus, Mr. Hole wrote that, with the single exception of one tree and "notwithstanding careful search by local officers this fungus has never been found up to date on the deodar", but advised "that a careful watch should be maintained by the officers responsible for our coniferous forests for the appearance of this pest on other species."

And on this supposed immunity of deodar, Mr. Hole built up the theory that the best method of combating this disease was to replace the infected pines by deodar.

In view of Mr. Hole's remarks, the news that deodar also in Lolab (Kashmir), is liable to the attack of this fungus will cause no little unpleasant surprise. *The Lolab is, perhaps, the only place*

in India where deodar is liable to this disease, at any rate to this extent.

The Lolab is a lovely little side-valley in Kashmir, about 130 square miles in area. It contains extensive stands of pure deodar or deodar mixed with blue pine, and size for size, it possesses the richest forests in Kashmir, or for that matter anywhere in the Himalayas. The valley is known for its loveliness and in the words of Dr. Duke: "There are few more charming spots in Kashmir than the Lolab. If it lacks the wild grandeur of the Sindh Valley, or the majestic scenery of Gurez or the calm expanse of Dal or Manasbal lakes, it has a sylvan beauty nowhere excelled."

A Working Plan for forests in this valley has just been completed and such trees as were attacked by this fungus were enumerated, special care being taken to assign the infected areas to Periodic Block I. The total number of deodar trees above 1′ in diameter, which were found attacked by this fungus, is as much as 1,262. The following table gives the number of these trees arranged under the standard diameter classes used in Kulu :—

Table showing the number of deodar trees attacked by Trametes Pini in P. B. I., Lolab, Kashmir.

Diameter Classes.	12—17″	18—23″	24—26″	27—29″	30—32″	33—35″	36—38″	39″ and over
Number of diseased deodar trees.	86	232	217	203	229	157	67	71
Percentage which diseased trees bear to healthy trees.	0·2	0·7	1·08	1·1	1·7	1·4	1·3	1·4

A total of 1,262 diseased deodar trees is big enough, when it is considered that this number refers only to about 1/5th of the total area under deodar which is roughly 40 square miles. It is true all badly infected areas have been assigned to P. B. I., and there are not as many diseased trees in other Periodic Blocks, nevertheless the total number of deodar trees so attacked can be put at double that number or about 2,500. This estimate refers only to such trees as bear the bracket-like sporophores but in

considering the degree of infection it is safer to consider that trees without sporophores, but which are immediately adjacent to a tree which has a sporophore are already infected. This, on a conservative estimate, will increase the number of infected trees to about 10,000!

The severity of attack varies in different places in Lolab the areas which are very badly infected being Dorus-wain and Chandigam.

From the table given above, it will be seen that all sizes down to 3' in girth are attacked. The youngest tree which bore sporophores was 1' and 9" in girth, and about 40 years in age., It is, therefore, evident that trees other than mature ones are also liable to this attack. The liability to damage, however, increases as the age of a tree increases. The falling off of percentage in higher diameter classes is due to the removal of mature trees under the previous fellings.

There is little doubt that the first species to be attacked is blue pine and not deodar. Enumeration in the *kail* forest showed that there were no less than 1,120 diseased *kail* trees in an area of about 15 square miles under the blue pine. In the past no effort whatsoever has been made to remove these trees, with the result that the affected *kail* have become centres of infection, and the disease is spreading rapidly all over the forest.

The effect of this fungus on deodar is a little different from that on *kail*. While in the latter case the core of a tree may be more or less completely rotten, in the case of deodar, the mycelia of the fungus search out and penetrate one ring only. This ring is the ring of weakness and during conversion logs or sleepers give way along this ring appearing very much like a cup shape. The attacked portion first becomes turmeric-yellow, but turns dark later on. In more acute cases of attack, several rings may be so attacked, or pockets of wood may be delignified and destroyed—the deodar becoming useless as timber.

The infection may spread either from root-grafts or by spores carried by wind or in both the ways. One other source of damage which is very often overlooked but which is at the root of this trouble in Lolab is the existence of certain holy shrines

(*ziarats*) at the edge of the forest. There are a number of such *ziarats* in Lolab, *e.g.*, at Dewar, Putshai, Dorus, etc. The trees growing in vicinity of these *ziarats* are considered to be too sacred to be touched and when these trees happen to be *kail* as they are at Dorus-wain and Chandigam, the result is that these trees on becoming old are liable to be attacked by *T. Pini*, and under the protection so offered by the holy enclosures, they become veritable centres of infection. In these cases, it is very difficult to do anything. The Forest Officer may be persuaded to remove these fungus-ridden trees, but he is helpless because no cooly would come and touch them. It cannot be definitely stated, whether in such places infection spreads more by root-grafts or by spores, but most probably both of these causes are equally operative. But there are instances in which an isolated diseased tree is found in the midst of apparently healthy trees, and the conclusion is irresistible that in the latter cases the wind is the more important factor. This conclusion would seem to be confirmed by the fact that the majority of sporophores occur towards the windward side. The number of sporophores borne by one tree may vary from one to four or five, or even more. The sporophores are generally found at the base of cut branches showing that the fungus gains access to the trees through wounds. The attacked trees are very liable to be upset by wind or snow.

The ravages of this fungus in the blue pine forests in Kulu have already attracted the attention of the Punjab Government but notwithstanding the fact that economic damage done by this fungus to deodar must be much more considerable than to *kail* the spread of this disease in the Lolab has received very little attention at the hands of the Kashmir Durbar. It is difficult to calculate the exact loss so caused to the State, but if the depreciation caused in the value of a diseased *kail* or deodar be taken on the average at 50 rupees only, the value of these (4,000) diseased trees is at least 2 lakhs of rupees. And if no special measures are taken to counteract the spread of this disease the economic loss to the State will continue to increase every year.

The old method of management (Selection System) offered little opportunity of combating this disease. On the other hand

ALSEODAPHNE OWDENI, PARKER.

Ganga Singh, del.

under this system every encouragement is given to these pests to spread from tree to tree, and it is impracticable to attempt to eradicate them owing to the enormous tracts to be worked over. It is now proposed to work these forests under concentrated regeneration system, and to cleanse each coupe as it comes under regeneration of these pests, and to keep the future crop more or less free of them by systematic cleanings and thinnings. But much will depend on the thoroughness of working and the angle of vision of the Durbar in regard to forest matters.

SHER SINGH, P.F.S.,
Kashmir State.

A NEW SPECIES OF *ALSEODAPHNE*.

ALSEODAPHNE OWDENI.—Parker, Arbor 18 m. alta; ramuli pallidi, glabri non crassi. Folia 8-12 cms. longa, 2·5—4 cms. lata lanceolata, in sicco fusco-nigra, apice basique attenuata, utrinque glabra, supra nitida, subtus pallida glauca, nervi laterales utrinque 4—7, *arcuati, paulum prominentes*; peteoli 5—10 mm. longi. Paniculæ e foliorum inferiorum axillis ortæ, folia superantes; pedunculi pedicellique graciles fere glabri. Perianthii lobi 2 mm. longi minute puberuli, ovati, in fructu caduci. Stamina filamentis puberulis, ordinis tertii filamentis glandulis 2 magnis juxta basim munita, ordinis quarti ad staminodia cordata reducta. Drupa 3·5 cms. longa, ellipsoidea, nigra, pedicello incrassato.

Cachar Hills, Assam circa 200 m. Nomen barbarum *Til Sundi*. J. S. Owden flowers and fruit; Upendra Nath 5,694 flowers May.

This species does not resemble the other species of *Alseodaphne from Assam, having much smaller, thinner leaves* and more slender shoots. The timber appears to be of good quality. We have seedlings of it in Dehra Dun raised from seed sent by Mr. Owden, but so far they have shown little promise of doing well. The plate accompanying the description (*vide* plate 16

has been drawn by Ganga Singh, Artist in the Herbarium of the Forest Research Institute.

R. N. PARKER,
I.F.S.

DEHRA DUN,
6th April, 1924.

The following is taken from the Times of 3rd March 1923 :—

EMPIRE FORESTS.

THE PRINCE ON FUTURE NEEDS. CALL FOR STATE ACTION.

The Prince of Wales as President of the Empire Forestry Association, presided yesterday, 2nd March 1923, at the first annual general meeting of the Association in the Guildhall, where he was received by the Lord Mayor. The large gathering which filled the Council Chamber included the Duke of Devonshire (Secretary for the Colonies) and representatives of the Dominions and Crown Colonies.

The Prince of Wales, in moving the adoption of the accounts and the report, said :—Though I cannot in any way claim sufficient technical knowledge of forestry to justify my being in the chair to-day, it is a subject which has always aroused my keenest interest, and I have had in the last three years unrivalled opportunities of realising the vast timber resources of our Empire. I have had the good fortune of visiting lumber-mills in Canada and Australia. The Empire Forestry Association deserves, and I trust will receive, support from all those throughout the Empire who recognise the vital importance of forestry to the life of the nation, and the need for looking ahead and promoting systematic planting and conservation of existing forests if we are not to lose

one of the most important resources of civilization (cheers). Without a cheap supply of timber any progressive community must face disaster, having regard to the many needs we have for timber in every-day life, for which a regular and cheap supply is essential. This, however, can only be secured by close attention to forestry in all its aspects.

LOOKING AHEAD.

If we are to accept the evidence of those who have made a study of the rate of consumption of timber, the world, within the next twenty years, will be faced with a timber shortage, if not actual famine. No time must be lost in making provision for future supplies. Steps must be taken to replant the vast forest areas devastated during the war, estimated in Great Britain alone at one million acres, of which probably not 5 per cent. have been replanted. In addition to the one million acres cleared during the war, it is estimated that in Great Britain there are three million acres suitable for afforestation and for no other purpose, and the time is opportune, particularly in view of the urgency of finding solutions for the problem of unemployment. (Cheers.)

The Empire Forestry Association, as a great voluntary organisation, can do effective work by bringing home, not only to the people of this country but to other countries of the Empire, the need for action by the State, and also by private enterprise, which, if judiciously encouraged, can do so much in this matter. This is one of the several directions in which, by propaganda the Empire Forestry Association should be able to render a most important Imperial service, and I trust that the doctrine will be preached, not merely in London but by speakers throughout the provinces, and especially in those country districts in which the need for action is apparent.

This country, however, can never expect to be able to grow all the timber it consumes, and certain woods must be got from warmer countries. Considering how almost every kind of climate can be found within our Empire, it is unsatisfactory to learn that by far the greater part of the timber used by us is brought from abroad. This state of affairs suggests an alluring programme of

operations for the Empire Forestry Association to carry out, with the hope of remedying, even to a small extent, this deficiency in the forest production and economy of the Empire. The need for systematic forestry must be more fully realised and the doctrine of self-regeneration of forests no longer relied on as the sole mean of propagation.

An Imperial Forestry Bureau.

Another aspect of the many-sided work of the Association is to promote the use of the lesser known timbers of the Empire, including those of tropical countries, many of which are scarcely known in commerce. In this connection the Association should find it an advantage to have made its headquarters at the Imperial Institute, with access to the varied collections of tropical timbers which are shown there, and to have established co-operation with the Timbers Committee of the Institute in bringing about a better knowledge of the timbers of our overseas countries and their commercial usage. The interests, too, of timber growers in Great Britain must not be overlooked, and every effort must be made to popularise the use of home-grown timbers, whose valuable properties have only to be known to be better appreciated. (Cheers.) From the Empire point of view, it is hoped that the Association will play an important part in organising the forestry section at the British Empire Exhibition of 1924 by establishing an Imperial Forestry Inquiry Bureau which will act as a clearing-house for information and be a key to every exhibit incidental to forestry at Wembley. I sincerely trust that this Association will gain the support throughout the Empire that it deserves, and that to become a member and supporter of the Empire Forestry Association and its sister Associations in the Dominions will be recognised as the duty of all those who realise the high importance of the varied work which the Association desires to carry out. (Cheers.)

Timber for Housing.

Lord Lovat, seconding the motion, said that no Government faced with the tremendous problem of housing could forget the

importance of builders having a plentiful supply of well-grown and seasoned timber.

The motion was adopted.

Lord Lovat said it was right that those who had control of State planting should be open to criticism and should not spoil the beauty of our beautiful land. A body such as the Association ought to be, commanding respect, might be of real value in advising what they ought and ought not to do. It was not their wish to defile and destroy the beautiful places of the country but when they heard figures such as those given by the Prince as to the damage done during the war they must be up and doing to get the situation right. In this Empire there were 1,000 million acres of wood. In some years we had imported up to 120 million pounds worth of wood, and of this barely 20 per cent. came from the Empire. At the Trade Conference with the Dominion surely such a subject as the production of timber would be seriously discussed.

Mr. Grainger (British Columbia) said the trouble from fires in Canada was now being checked.

The Duke of Devonshire, moving a vote of thanks to the Prince of Wales, said that in any part which he had in preparing the agenda for the Dominions Economic Conference he would not overlook the matter in which the Association was interested. Referring to the British Empire Exhibition, he said there had been periods of anxiety, which he hoped had now once for all been brought to a conclusion. A very heavy amount of hard work was necessary to make the Exhibition a success. But under the guidance of the Prince of Wales, and with the cordial and generous good will of all classes, he was confident that the Exhibition could be a success.

The Prince of Wales, in reply, said he fully realised that the forestry of the Empire wanted organising. He had seen people burning wood in Australia simply because they could not get rid of it. Such a sight brought home to one the great work which the Assoc ation was doing and was going to do.

Among those present were :—

Lord Milner, Lord Buxton, Lord Clinton, Lord Plymouth, Lord St. John of Bletso, Lord Lamington, Lord Rothschild, Lord Aberdare, Lord Lyell, Lady Aylesford, Lord Dynever, Lords Leven and Melville, Sir T. Henderson, Sir W. Schlich, Sir E. H. Tennyson d' Eyncourt, Mr. J. F. Hope, Professor Fraser Story, Lieut.-Colonel D. W. Drummond, Mr. Gordon Selfridge, Dr. Simms, Sir Lawrence Wallace, Sir B. G. Elliott, Sir F. Duke, Sir B. Robertson, Sir Sidney Harmer and Mr. Morrison.

ANNUAL REPORT OF THE EMPIRE FORESTRY ASSOCIATION, 1923.

During the year 114 individual Members have joined the Association, whose total subscriptions amount to £205 5*s.* 0*d.*; fourteen Forestry Departments, Institutions and Trade Organisations have been elected Affiliated Members, subscribing a total of £152 19*s.* 0*d.*; receipts from Life Members and Donors amount to £150 and £10 10*s.* 0*d.* respectively. Three resignations and the death of three Members represent a loss in income amounting to £14. Membership now totals 356, being an increase of 142 during the year. Although membership increases but slowly, it is hoped that many new members may be enrolled at the forthcoming British Empire Exhibition at Wembley, where the Association will establish an Empire Timber Enquiry Bureau.

The most important event in the forestry world during the year was the holding of the British Empire Forestry Conference in Canada, at which an appreciative letter from H.R.H. The Prince of Wales, President of the Association, was read. The Conference was attended by the Chairman—Lieut.-Colonel G. L. Courthope, M.P.—as an official delegate, Lord Strafford and Mr. R. P. Dalley as associate delegates.

The last number of the Empire Forestry Journal contains a fairly full record of the proceedings at the Conference. Members will note with satisfaction the Resolution welcoming the incorporation of the Empire Forestry Association, and will be glad to hear that the Canadian Forestry Association have recently applied for Affiliated Membership, and are offering a subscription of

£50 an example which it is hoped will be followed by other Forestry Associations throughout the Empire.

Negotiations are proceeding with the Standing Committee on Empire Forestry which it is hoped will result in the Journal of the Association becoming the acknowledged medium for the publication of Official Reports and Statistics collected from time to time by the various Forest Services throughout the Empire.

The Council regret that, owing to lack of funds, it has been impossible to proceed with the establishment of a permanent exhibition of the commercial timbers of the Empire referred to in the last Annual Report. It is hoped, however, that this work may be resumed after the close of the Wembley Exhibition, when samples of various Empire timbers exhibited there will doubtless be available.

A site has been secured in the Forestry Section at Wembley and a suitable building is in course of construction which will become the Headquarters of the Association during the period of the Exhibition (April to October). A complete list is being prepared of every Timber Exhibit which will be on view at Wembley, and it is hoped to secure small hand samples of each for reference purpose.

The Council are not unmindful of the interests of the woodland owner in Great Britain and have been represented on the Committee dealing with the English Forestry Exhibit, where efforts will be made to popularise the use of home-grown timber and to create interest in afforestation generally.

Forestry has suffered a great loss during the present year owing to the death of Mr. M. C. Duchesne who, before being appointed to the Governing Council, was the first Honorary Secretary of the Association.

An alteration in the Rules is proposed relating to membership and rates of subscription, the Council being unanimously of opinion that steps should be taken to bring into membership every forest officer of whatever grade throughout the Empire.

It is gratifying to note the increasing demand for the Journal now edited by Mr. Fraser Story, to whom the thanks of the Association are due for the excellence of his work.

The Governing Council have placed on record their appreciation of the work undertaken by their Solicitor—Mr. Ernest Salaman—who has remitted his charges for professional work undertaken for the Association during the past year.

There will be certain vacancies on the Governing Council which will be announced at the Annual General Meeting. Members desirous of nominating representatives should complete the Nomination Form which should be handed to the Secretary before the commencement of the Meeting.

SILVICULTURAL NOTES FROM BIHAR AND ORISSA.

The following silvicultural Research work has been carried out in Bihar and Orissa during the last two months :—

(1) Two duplicate series of plots were laid out in Angul Division to test the comparative results of the method of working *Dendrocalamus strictus* forests proposed for that division and of that prescribed for Sambalpur Division.

In each series one plot is being left unworked as a control plot; a second plot is being worked under a 3-year rotation, all culms being removed except 8 which may be of any age,—the proposed Angul system; while in the third plot, which is also being worked under a 3-year rotation, all culms are being removed except all those under 18 months age and 6 culms over 18 months age—the Sambalpur system. In all plots the number of new culms produced will be enumerated annually.

(2) Two plots were laid out in the dampest types of *sal* forest in Angul division to test whether fire-protection is beneficial or harmful to the establishment of *sal* regeneration. A complete enumeration of all species present was made, both in the overwood and underwood, and similar enumerations will be made at intervals of 5 years.

(3) Two plots were laid out in drier types of *sal* forest in Angul division to test whether firing the area annually will prove harmful to the establishment of *sal* regeneration. Enumerations of the crop will be made quinquennially.

(4) Two plots were laid out in Angul division with the object of seeing whether in mixed forest containing a dense underwood of bamboos (*Dendrocalamus strictus* and *Bambusa arundinacea*), it will be possible to kill out the bamboos and obtain natural regeneration of the principal species in the overwood within a reasonable time by cutting the culms and burning them for one or two successive years.

It is interesting to note that on an area of similar forest which was treated in this way two years ago with the object of planting it up with teak there is now a splendid crop of fully established seedlings of *Adina cordifolia*.

(5) Six experimental plots have been laid out in the *sal* forests of Puri Division, where past fire-protection has resulted in natural regeneration of *sal* being killed out by invading evergreen species, with the object of seeing whether by annually burning over the forest natural regeneration of *sal* can be reobtained within a reasonable period of time.

Two of the plots consisted of strips one chain in width in forest with *sal* predominating in the overwood, on one of the strips the whole forest was clearfelled, while on the other strip all species except *sal* were felled.

Two plots consisted of groups 2 chains square situated in similar forest and treated respectively in the same way as the strips.

Two further plots, one a strip and the other a group, were laid out in forest containing hardly any *sal* in the overwood. On both these plots all trees except *sal* were felled.

In the case of all the above 6 plots any existing natural regeneration of *sal* was uprooted, while the material felled will be burnt in May. On two of the plots the number of *sal* seedlings appearing in the first year will be enumerated month by month while in all the plots the number of established seedlings will be enumerated once a year just before the plots are fired over.

(6) One plot was laid out in *Strychnos Nux-Vomica* forest in Puri Division to test the effect of pruning, pollarding and coppicing this species on the production of seed. The plot was divided

into 4 sub-plots. In one sub-plot the trees were coppiced; in another one they were pollarded; in the third sub-plot they were lightly pruned; while the fourth sub-plot was left untreated as a control plot. The weight of dry seed produced by each tree in each sub-plot will be annually recorded.

(7) One plot was also laid out in *Strychnos Nux-Vomica* forest to test the effect of coppicing dying trees on the production of fruit. The plot was divided into 2 sub-plots in one of which all dying trees were coppiced, while the other plot was left untreated. The height, diameter and condition of each dying tree in each sub-plot was recorded. The weight of dry seed produced by each tree will be annually recorded.

(8) One plot was laid out in the Puri *Casuarina* plantation to test the possibility of obtaining regular regeneration by coppice or pollard shoots. The plot was divided into 4 sub-plots in one of which the trees were coppiced flush with the ground, while in other 3 sub-plots the trees were pollarded at heights of 1, 2 and 3 feet respectively. The diameter, height and condition of each tree felled was recorded.

(9) Three plots were laid out respectively in 3, 4 and 5 year old *Casuarina* crops to test the effect of pruning on diameter and height growth. Each plot was divided into 2 sub-plots in one of which the trees were pruned of their lower branches up to about one-third of their total height, while the other was left unpruned as a control plot. The diameter, height and condition of each tree was recorded in each sub-plot.

(10) Four plots have been laid out in *Casuarina* crops planted last rains 4′ × 4′, 6′ × 6′, 8′ × 8′, and 10′ × 10′ respectively with the object of ascertaining the optimum planting-distance for *Casuarina* plantations. Careful records will be maintained of the cost and volume production of each plot, and of any sub-plots which may be subsequently formed and subjected to different methods of thinning.

(11) Sixteen plots have been laid out in the Puri *Casuarina* plantation to ascertain the effects of early thinnings of different degrees at different ages. The plots are being mechanically thinned

(½, ⅓ or ¼ of the crop being removed) according to the following scheme, duplicate plots being laid out for each particular method of thinning.

Series.

A ½ *thinning* at 6 *years* followed *by* ½ *thinning* at *13 years.*
B ¼ ,, ,, ,, ,, ,, ,, ⅓ ,, ,, 13 ,,
C ¼ ,, ,, ,, ,, ,, ,, ⅓ ,, ,, 10 ,,
followed by ½ thinning at 15 years.

D ½ thinning at 8 years followed by ½ thinning at 14 years.
E ¼ ,, ,, ,, ,, ,, ,, ⅓ ,, ,, 14 ,,
F ¼ ,, ,, ,, ,, ,, ,, ⅓ ,, ,, *12* ,,
followed by ½ thinning at 16 years.

G ½ thinning at 10 years followed by ½ thinning at 15 years.
H ¼ ,, ,, ,, ,, ,, ,, ⅓ ,, ,, 16 ,,

In each plot the volume of each individual tree thinned out was carefully measured. The total volume production of each plot will be compared at the age of 20 years.

In addition to the above experimental research work 12 *Casuarina*, 5 *sal*, 3 *Anogeissus latifolia* and 1 teak Sample-plots have been laid out in the Circle.

J. W. NICHOLSON, I.F.S.
Provincial Research Officer, Bihar and Orissa.

18th April 1924.

REVIEWS.

TOPOGRAPHICAL MAP-MAKING.

AN ABSTRACT OF "THE MAKING OF A TOPOGRAPHIC MAP," BY J. K. PEARCE IN "THE MADRAS FOREST COLLEGE MAGAZINE," VIII, 3RD MARCH 1924.

The Method is described as the "Topographical trailer tape-Improved Abney Level" system, and is especially applicable to the mapping of an area with a view to preparing economical "logging" operations.

The mapping set consists of :—

(1) An unusually large and convenient form of Abney Level —*the arc of which* is graduated to give direct readings of the difference in height in feet for horizontal distances of 1 chain.

(2) A steel tape 2 chains long, with a trailer of about ½ a chain : the reverse side of the 2nd chain and the trailer are graduated to correspond with the graduations on the Abney arc.

(3) A special compass—with a needle instead of a dial,—folding sights,—and a movable arc on which declination can be set off—so as to give true bearings : the whole is mounted, through a ball and socket, on a sharp-pointed stick which may be stuck in the ground. The instrument is said to facilitate the running of straight lines through jungle.

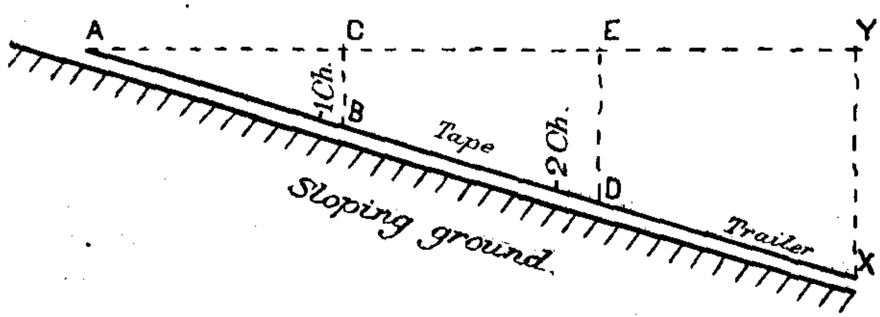

Figure illustrating the use of the trailer tape.
AX = Tape and trailer, = Horizontal.

The Abney reading gives the height in feet per horizontal chain, *i.e.*, CB, the point B on the reverse of the tape will be marked with this height. Therefore, if the gradient in feet per chain be known from the Abney, and the tape be grasped at the corresponding mark, the length AB on the slope will be equivalent to a horizontal distance of 1 chain. By doubling the Abney reading ED will be obtained and a 2 chain horizontal distance measured. In this way correct horizontal distances may be measured on a slope without any computation.

The map is made in strips—run either across or between base lines—the strips crossing the contours and the base lines running along valleys or ridges or other suitable places.

Base lines.—These can be surveyed accurately with a transit and a level, or less accurately with the mapping set—2 Abneys being used, one by the leader and one by the follower who check one another at each "shot." Base lines need not be straight, but as long sights as possible should be taken. They are then plotted to a suitable scale, *e.g.*, 200′—300′ or 400′ to the inch. The strips are then plotted, their width varying from six chains to two in open or closed jungle according to the surveyors range of vision. Points to mark the strips are inserted on the map, scaled off and pegged out in the field.

If a level is used, levelling should be deferred till the strip stakes are placed—the level of each stake being marked with a small peg on which the level is taken: if trigonometrical levels be used the levels of the stakes are set off from the nearest point with an Abney. The base map is then pricked off on to another sheet, which is cut up into strips for work—strip by strip—in the field.

Field work.—The surveyor and the compassman set out, the former with his sketching materials and his strip mounted on a board, the latter with compass and trailer tape. The compass is set on the proper bearing—ascertained from the base map—of the corresponding stake on the second base line—a tree or other prominent mark which lies on that line of sight is noted—as far ahead as possible. The Surveyor now stands with his feet evel with the strip stake level peg and sends the compassman

plus compass and the fore end of the tape ahead for one or two chains—he sights the Abney on a spot on the compassman previously found to be at the same height as the Surveyor's eye—grasps the tape at the graduation as given by the Abney and moves the compassman till the tape is taut: the latter will now be standing exactly one or two chains horizontal distance from the stake. A final reading is taken with the Abney and the point with its elevation marked on the strip map. (*N.B.*—If a one chain "shot" is taken the Abney gives directly the height above or below—if a two chain "shot"—the reading must be multiplied by two).

From the new point—facing the stake, the Surveyor orients his map and sketches in the contours and features on either side of the centre line of the strip according to a predetermined contour interval in hilly districts, 10′ in flatter is recommended).

The compassman meanwhile goes ahead another one or two chains and the operation is repeated, the Surveyor standing on the new point facing the old. When the compassman reaches his first sighting point he fixes another and so on.

Short "shots" are advised instead of clearing undergrowth and a mirror fixed to compassman's head at Surveyor's eye height is said to be useful for flashing position in dense jungle. Coolies with bill-hooks are useful. On reaching the 2nd base line—the error in closing on to the corresponding stake should be noted. The maximum error in elevation permitted in a mile run is ½ a contour interval—it is usually much less: bigger errors must not be passed.

Using a single base line—when the end of the strip is reached the compassman "right turns," goes the width of a strip, "right turns" again, and returns to the base line parallel to his 1st line.

Finished strip maps are then pasted on the base map and errors in line and distance corrected by shifting the strips and cutting them into sections, which may be shortened or lengthened by the insertion of small pieces as required. No change in the field sketches should be made. A tracing is then made on which any corrections, *e.g.*, the joining of contours that don't meet—are

made. Streams and large contour intervals (100) should be joined first, artificial features last.

G. F. W.

EXTRACTS.

THE EFFECT OF FIRE ON REGENERATION.

The Forest of Sangseri is situated at 5,700 feet above sea level in the Western Himalayas, and comes under the jurisdiction of Rawalpindi East Forest Division, Punjab. It consists of a pure forest of *chir* pine (*Pinus longifolia*). During 1917-18-19 regeneration fellings were done, and about seven trees per acre were left as seed-bearers. In June 1921 a fair amount of regeneration was to be seen, but at this time the forest was maliciously burned. The fire did enormous damage, destroying the new growth of seedlings, charring the soil to a depth of six inches in places, and even disintegrating the rocks of sandstone. In order to fill up the blanks to complete the new crop, artificial regeneration was resorted to.

In early July 1921 *chir* seed was sown in patches of three feet by three feet, the patches being five feet apart. Where the ground was very steep and there was the danger of the seed being washed away, dibbling was done. The ground was hoed to a depth of eight inches and the soil properly loosened. The charcoal ashes were mixed with the soil wherever practicable. In the end of July 1921 most of the seed had germinated, the best examples being where the sowing had been done in patches. Natural regeneration was also coming up well, as some of the seed-bearers had not been badly damaged. In the burnt areas the seedlings were taller and more healthy than in the unburnt areas.

In August 1922 the area was inspected and the following points noted:—(1) In the burnt area, growing in ashes, many seedlings were up to one foot one inch in height. (2) In the burnt

area, but not growing in ashes, seedlings were up to eleven inches in height. (3) In unburnt areas the seedlings were up to nine inches in height. When inspected in September 1923, many *young plants in the burnt area, growing in ashes, were discovered* to be over three feet in height, the best of all being three feet four inches, and showing very healthy growth all round. These plants are now in their third year, as they were sown in July 1921. The young plants in the unburnt area are eighteen inches and less in height, and do not show such healthy growth. In June 1921 the fire was described as very harmful, but the example proves that fire can be employed *with great benefit in* areas under regeneration.—[*H. S. D.* in *Sylva*, *No.* 4, 1923.]

A REVIEW OF INDIAN FOREST MANAGEMENT.

After some years spent by the Indian Forest Department in the organisation of the forest estates made over to its management, the necessity for the introduction of some sort of silviculture and forest management began to make itself apparent. Sir Dietrich Brandis, who was appointed to the charge of the Pegu Forests in 1856, laid down the first system of management. Having to deal with large areas, often imperfectly explored, in which perhaps only one species in a mixed crop was marketable, he had no option but to employ a rudimentary selection system based on an arbitrary girth limit and to regulate the yield by numbers of trees of this exploitable girth. This system came to be universally applied in dealing with high forest, and it is only within the last 10 years that efforts have been made to introduce something better and more in accordance with the highest ideals of silviculture. It is not proposed to enter into a discussion as to the merits and demerits of the recognised silvicultural system, this has been adequately dealt with in the *Indian Forester* *; indeed, India is at length developing a silviculture of her own, influenced but not necessarily bound by the theory of European forestry. Silviculture is not an exact science, yet its principles

* *Indian Forester* December 1921 —Forest Management—C. G. Trevor.

are of world-wide application and guided by these fundamental rules every country must work out its own salvation.

The great failing in Brandis's management was that the age classes, or what girth or diameter classes were taken as corresponding to the age classes, were never distributed on the ground in accordance with the ideal selection forest, so that while in theory tables of the different age classes might appear to be normal, in practice it often became impossible to take out the calculated yield by any fellings which could deserve the name of silvicultural fellings. Alternately in certain compartments containing a large proportion of the older age classes and copious advance growth, the limitation of the number of trees to be removed was often prejudicial to the best silviculture, more especially as the felling of sound immature trees was almost always prohibited. In order to get over the latter difficulty prescriptions in working plans were often flouted, to the benefit of silviculture to be sure, but with disastrous consequences when revision of the plan became necessary. The gravest objection of all was that in the too many cases natural regeneration was not obtained, and there being no obligation to regenerate certain areas, this, the *sine qua non* of management, was left entirely to chance.

In division after division after being in operation for 30 years or more the system became unworkable, and steps were taken to introduce silvicultural systems in which the regeneration of a normal area and a normal distribution of the age classes became of paramount importance. Now no enlightened management can exist without a knowledge of the silviculture of the trees being dealt with, and this knowledge is being built up year by year both by research officers and the ordinary members of the executive staff, many of whom are conspicuous for the good work they have done. The silviculture of many of the important species has been worked out to a satisfactory conclusion, and a great impetus has consequently been given to this branch of learning; but of course much remains to be discovered, and even where regeneration, whether natural or artificial, has been reduced to a routine new refinements in technique are constantly being elaborated

It will be of interest to foresters in various parts of the Empire to read a short account of silvicultural systems actually being practised over considerable areas. A full account of the systems used in Northern India, together with methods of calculating and regulating the yield has already been written and the book is now in the press.* It would be out of place in this short article to attempt to cover the ground dealt with in this publication, so that all that will be attempted in this article is to describe in a general way the chief methods used in the management of the high forest of the principal species.

I. CONIFERS.

The conifers of importance are the deodar (*Cedrus Deodara*), the pines (*Pinus excelsa* and *longifolia*), the spruce (*Picea Morinda*), and the silver fir (*Abies Pindrow*). *P. longifolia* has for many years been managed in Kumaun under the shelterwood compartment system; this management has now been extended to the Punjab forests. Regeneration is comparatively easy with six to eight good seed-bearers to the acre, if only fire protection can be obtained. Owing to the incendiary fires of 1921 the working plans branch in the United Provinces have been considering whether it may not be necessary in the future to take a step backward and to adopt the modified system employed by the French in the pine forests of Corsica. This would be a retrograde step and would result in inferior financial results, and certainly inferior silvicultural technique, and it is sincerely to be hoped that the good sense of the people will not render this necessary. The chief faults in the past have been slowness in completing regeneration and not sufficiently drastic felling. It is now admitted that in regeneration fellings the correct number of mother trees should be selected and everything else cut.

The blue pine (*P. excelsa*) in the Punjab is regenerated in a similar way, only more seed-bearers are retained, and an admixture of deodar is generally attempted either by reserving this

* "A Handbook of Forest Management for the United Provinces," Trevor and Smythies, Supdt., Government Press, Lucknow, a review of which will appear in our August number, HON. ED.

species among the mother trees or by artificial sowing and planting.

The deodar is by far the most valuable of the conifers, and forests containing this tree have been under management for nearly 50 years. Brandis's selection system was in use up to ten years ago, with various results, depending to a great extent on the incidence of the grazing. Every sort of felling has been made under this system, as beyond regulating the number of trees to be cut everything else was left to the discretion of the man who marked the felling. Good regeneration is found in many places, but it is more often due to chance than to well thought out management.

The system now in force is the shelterwood compartment system, leaving the mother trees 30—50 feet apart. Compartments felled over in this way, cleared of lop and top and felling slash, and closed to grazing, have generally regenerated very well. Areas have been regenerated in one year by long-sighted management and taking full advantage of a seed year. It is considered essential to complete regeneration as quickly as possible, even with artificial help, rather than to prolong the process and get the regeneration area full of weeds.

This system has lately been extended to the management of the spruce and silver fir forests of the Himalayas, which very much resemble the forests of the interior wet belt of British Columbia, but complete success has not yet been obtained.

The most difficult of the Himalayan forests are still managed under a selection system, but a much improved system under which the yield is regulated by volume. The exploitable size has been abolished, and everything felled down to the diameter class enumerated counts against the prescribed yield.

II. SAL.

The sal (*Shorea robusta*) is the most important broad-leaved timber tree of the Sub-Himalayan foothills and flats. In new working plans the tendency is to regenerate under a shelterwood, partly by coppice and partly by seed, or in localities not subject to frost to obtain a more or less suppressed advance growth before

the main fellings, and then to clear cut and regenerate by coppice, completing the crop artificially by sowing sal with or without field crops, or by filling with supplementary species. Much more remains to be discovered about the silvicultural peculiarities of the sal seedling. The North Kheri Division of Oudh is still under a transitional selection system, and here selection has been elaborated so far as to provide a graph of the age classes of the actual growing stock in every compartment with the normal selection forests; not to bind the marking officer, but in order to show him exactly how he is situated as regards his age classes.

In Bengal and Assam, clear felling and artificial regeneration with field crops is looked upon as the solution of the problem; but in the remoter valleys it is doubtful if sufficient labour can be obtained. Where labour is available and fencing against wild animals has been possible, very excellent results have followed.

III. TEAK.

The easiest method of regenerating teak (*Tectona grandis*) is by clear felling, followed by artificial regeneration with field crops. The cultivators undertake for a moderate payment per 100 plants to weed the young teak along with their crops. The teak seeds are dibbled at stakes 6ft. × 6ft., and very young plants are used as fillers where necessary. The latest development is to broadcast miscellaneous species between the teak, so that the ground may be covered quicker and the costs of weeding after the first year reduced. The extent of the work being done in Burma may be judged by the fact that for the year ending 31st March 1921, 84,723 acresof these plantations existed in this province. Burma and Bengal have almost perfected this work, and any forester who may think of experimenting along these lines should certainly obtain all the literature on the subject from the Forest Research Institute, Dehra Dun. As regards the natural regeneration of teak, this has been obtained from seed stored in the ground after clear felling and burning. It appears that the young teak will not stand shade or drip, and must have complete overhead light. Regeneration has also been got by elaborate and repeated clearings, but most

authorities prefer the simpler and less costly system of régenerating with field crops.

THE CALCULATION OF THE YIELD.

Where the periodic block system is in force no complete allotment of compartments to periods is attempted. Sometimes only periodic block I. or the regenation area is laid down ; in other cases both period block I. and the last period, containing areas recently regenerated, are definitely allotted. In the case of sal it sometimes becomes necessary to consider which compartments should come under regeneration in period II., so that these may receive special treatment. Now that yield tables are becoming availabe, thé use of reduced areas to compensate for quality are being more employed, and volume tables by quality classes render the calculation of the yield and the estimation of the outturn more accurate and reliable than was previouly possible. In such plans the calculation of the yield from main or regeneration fellings is by volume :

$$\text{Yield} = \frac{V + (i) \times \frac{P}{2}}{P}$$

Where V = Volume standing in the regeneration area.
i = current annual increment of above.
P = period.

The intermediate yields in other periods are by area.

When it is necessary to calculate the yield by volume for the whole working circle, to include both final and intermediate yield Heyer's or Von Mantel's methods are used, and an attempt is made to allot the proportions of the yield to come from final and intermediate fellings. These methods are also employed in the case of selection forests A modification of these methods has to be made to compensate for the difference in age between the youngest diameter class included in the enumeration list and the total rotation. These modifications are mathematically explained in the handbook referred to.

Regulation of the yield by area is employed for all clear felling systems ; in shelterwood fellings regulation by volume is generally

preferred, but this is not universally so. The days of one stereotyped silvicultural system and method of calculating the yield have passed, never, it is hoped, to return. We aim at using that silvicultural system which will give the best results in the case of each individual working circle, with all due consideration to the silviculture of the tree we are dealing with in its special environment, and the fixed conditions of situation, climate and market requirements which differ not only from one division to another, but from one working circle to another. We employ these methods of calculating and regulating the yield which suit our purpose best in each individual case. It is sometimes thought that such intensive forestry can only be practised on small areas. In many divisions of Northern India such systems are in operation on areas of 50,000 acres. In the much larger divisions of Burma very intensive work is carried on in the areas under regeneration, though these are often far short of the normal area which should be dealt with. Real silviculture encourages the zeal of the whole subordinate staff; once have a definite area under regeneration in which something is going on, in which the staff can see the plants growing, and half the battle is won. Many instances can be given in which the sight of a completely regenerated crop growing like a field of corn excited the greatest enthusiasm from the mere forest guard who had watched over it from the beginning If only this atmosphere can be obtained, instead of the apathy so much complained of, men will work all day in pouring rain without a thought of complaint. Indian forestry as a whole has still a long way to go, but in these divisions in which scientific forestry has been developed by the unremitting toil of the officer-in-charge, the visitor may see the whole art of the adept displayed, and will carry away with him the impression that Indian forestry much of interest to other members of the profession, no matter has from which country he may come. [*C. G. Trevor, I.F.S.*, in *Empire Forestry Journal, II, 2nd December 1923*.]

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BOTANICAL NOTES ON SOME PLANTS OF THE KALI VALLEY.

The Kali river, for a considerable portion of its course through the Himalaya, forms the boundary between Kumaon and Nepal and, like the other deep Himalayan valleys, contains a number of plants that are not at all well known. It is the only known locality for several shrubs, but it is probable that these plants also occur in West Nepal, and that the Kali valley is only the extreme limit of their range. We know next-to-nothing of the flora of Central and Western Nepal, as is very evident from the recent correspondence in the *Indian Forester* in which Messrs. Collier and Lambert show that, contrary to what has been believed hitherto, there must be extensive forests of deodar in Nepal.

The lower portion of the Kali valley is not difficult of access. The upper portion known as Byans is not easy to reach. It was visited twice by the late J. F. Duthie in 1884 and 1886, but since then practically nothing has been collected in Byans. In July last I was fortunately able to visit Byans and follow a good deal of Duthie's route, and although nothing much in the way of new discoveries was to be expected, as Duthie had collected very thoroughly, I was able to bring back a number of specimens of plants hitherto only known from one or two gatherings. The following remarks may therefore be of interest.

Duthie collected amongst other things a *Leptodermis*, superficially very like *L. lanceolata*, Wall., but differing in several respects from that species and occurring much lower in elevation

than *L. lanceolata.* Although I have long held that it was an undescribed species, I hesitated to describe it on a single specimen. Having now seen it growing I feel there is no doubt that it is new.

LEPTODERMIS RIPARIA, Parker; *L. lanceolatae*, Wall, affinis sed ramulis, bracteis, corollisque pubescentibus, foliisque minoribus et bracteis non cuspidatis differt.

Frutex 2m. altus, ramulis hornotinis pubescentibus. Folia 2—4 cms. longa, 7—15 mm. lata, lanceolata, apice basique attenuata, pagina superiore et subtus in nervis scaberula, ciliata; nervis lateralibus utrinque 4- 6; petioli 1—3 mm. longi. Flores sessiles 3 vel 5 subcapitatim fasciculati apice ramulorum gracilium, singuli bracteis binis in involucrum connatis cincti. Calyx 2—5 mm. longus lobis ovatis, ciliatis 1 mm. longis. Corolla 1 cm. longa, alba, anguste tubulosa, exter puberula, intus pilosa, limbo 5-loba, lobis ovatis. Stamina 5, infra faucem corollae inserta. Stylus 5-fidus, inclusus. Capsula subcylindracea, 4—5 mm. longa Semina linearia, utriculo fibroso laxe inclusa.

Banks of the Kali River near Balwakot, 900 meters, *Duthie* 5636; *Parker* 2051, 2110.

This species is found fringing the banks of the Kali river above and below Balwakot. I also noticed it on the edge of one or two of the side streams, but did not see it anywhere away from water or much above 3,000 ft. elevation. It flowers in July.

Stephania gracilenta, Miers. This plant was described by Miers in 1866 from Wallich's Nepal specimens, but has been omitted by an oversight from the Flora of British India. It is a slender twiner of rather moist forest undergrowth and has red flowers.

Close to Budhi in Byans one comes suddenly across *Berberis Koehneana*, C. K. Schn. With its large panicles of flower it is a very striking plant, forming a shrub 4—6 or even 8 ft. high. On the Kumaon side of the river I only saw it near Budhi, but on the Nepal side it is found several miles further up the valley.

Between Budhi and Garbyang another species of *Berberis, viz.*, *B. Usteriana*, Parker, is abundant. It is a shrub knee-high and a very free flowerer. It grows on open sunny hill-sides at about 10,000 ft elevation. This plant was described on specimens collected by Duthie as *B. Jaeschkeana*, C. K. Schn. var. *Usteriana*, C. K. Schn. in Bull. Herb. Boiss. 1905, p. 399. Schneider at the time did not seem altogether satisfied with its position as after describing it he remarked "vielleicht ist sie eine gute Art". *Berberis Jaeschkeana* C. K. Schn. is based on Falconer No. 97 in the Natural History Museum, Vienna. The Director very kindly sent me this specimen for examination and I have no doubt that it is not a good species, being only a dwarf form of *B. umbellata*, Wall. Wallich's types of *B. umbellata* look very different to the plants ordinarily met with in the West Himalaya, which mostly resemble *B. Jaeschkeana* very closely or are intermediate. Occasionally I have found specimens altogether like Wallich's, but only when the plant is growing in forest undergrowth.

Thanks to the co-opèration of Dulip Singh, Patwari of Byans, I have been able to obtain seed of both *B. Koehneana* and *Usteriana* for distribution to Botanic Gardens in Europe, where these species are likly to be of ornamental value.

In Budhi I expected to find another species of *Berberis, viz.*, *B. Duthieana*, C. K. Schn. in Bull. Herb. Boiss. 1908, p. 200. This plant was collected by Duthie in Nepal opposite Garbyang, and I looked for it in this area but could not find anything that exactly corresponds with Duthie's No. 2696. I have however little doubt *B. Duthieana* is only a somewhat abnormal specimen of *B. Koehneana*. It seems to be a shoot of the current year that has flowered and the inflorescence is much reduced being paniculate in one case only, the others being racemose.

Astragalus aegacanthoides, Parker, is very local in the upper Kali valley. Near Nabi it is abundant in open blue pine forest covering perhaps one-third of the surface of the soil and forming rounded tufts or cushions up to 6 feet across and 12 inches deep. Like the *Berberis* mentioned one comes across it quite suddenly and finds it abundant for a few miles, after which it abruptly stops and is not met with again.

These sudden appearances and disappearances of plants in Himalayan valleys are evidently due to the considerable differences in rainfall and elevation that occur in places only a few miles apart, and they seem to affect the woody plants much more than they do the hérbs.

R. N. PARKER, I.F.S.

FIRE PROTECTION IN SAL FORESTS.

The subject of fires in the *sal* forests of India requires a good deal of study. We dread these fires, as they seem to sweep all young growth before them, but the rains come, the trees put on new leaves, and we forget everything about them. The only visible signs of the catastrophe remaining are a few dry twigs here and there In the Orissa Garjats, which have extensive *sal* forests, these fires are so common that one can count dozens a day in the fire season. The atmosphere is turned smoky for a time, and this period passes off as fires sweep over all the areas they can have an access to. We call these fires creeping ground fires, as there is no tall grass on the ground, and the fire is fed

only by dead fallen leaves. They scorch trees and shrubs to a height of eight or ten feet only, and as the scorched leaves again give the ground uninterrupted covering, this gives rise to a second fire season about a month later. After this very little is left in the forest to burn, and as with the advancing season some showers of rain bring new grass to the ground, and new juicy foliage covers the scorched trees and shrubs, the fire season automatically ends. These Garjats, over 20 in number, have now each a Forest Department under more or less trained Forest Officers, but I have seen nowhere fire protection a thorough success. A newcomer is startled at the sight of these fires, but finding to fight so many of them a hopeless task, his enthusiasm subsides, and he becomes gradually accustomed to new surroundings. He consoles his mind with the idea that fires did not come that year, they existed from time immemorial, and when he finds fires leave no bad signs behind, and the virgin forest in an inaccessible part of the country presents a glorious sight to his eyes, his ideas undergo a change, and he begins to look on the utility of the fire measures with some sort of suspicion. This suspicion about the fire measures is not confined only to the lower ranks of our service, rather it has affected our advanced professional leaders. Mr. Trafford, I.F.S., says as follows about rigid fire protection measures in *sal* forests:—

"In Jalpaiguri Forests rigid fire protection has been very detrimental to the *sal* forests. *Sal* is far more fire resistant than most species, and fire protection tends to encourage the latter at the expense of the former."

This is the experience of an experienced Forest Officer about *sal* forest fires in Jalpaiguri Division, which, if I am right, is a wet zone of *sal* forests; and as for dry *sal* forests of Orissa Garjats it is admitted by a majority that these ground fires do little harm. Thus there is a good number of men among us who say that rigid fire protection in *sal* forests of India, where fires come annually, is only humbug, but with all this there are officers who are advocates of a rigid fire protection for *sal* areas. They pin their faith in the fact that without fire protection regeneration is simply impossible This is no doubt a point for common

sense. They say that tender seedlings of one year old can not stand fires, and we are to admit this part of their argument as valid, but *we are also to answer the* question as to how forests that are subject to annual fires contain so much young growth, and in fact if this question is carried further we can well ask how the old trees came on the ground when fires *raged unchecked* for centuries. I believe if we can find an explanation for this question we will go very near the solution of this problem, and *we will also find an answer*, for these advocates of *rigid fire* protection who believe, that it is only by rigid fire protection that regeneration can be had.

Mr. Nicholson's *experiments* no doubt *will lead to some* useful results in course of time, but I say why shut our eyes to existing facts, and I ask what explanation we offer for the existence of young growth in *sal* areas, where there is no check on the fires. Is the origin of that young growth due to immunity of *sal* seedling to fires, or we are to presume that its origin is not from the seeds at all? Anyhow it is a question for more careful study, and if we are to presume that regeneration can come without fire protection we are to decide how far our present policy of rigid fire protection is for the real good of the forests. If opinions of the *persons who have spent the major part of their* life in *sal* forests are gathered, I think we can add something to our existing knowledge; so it is with this object in view that this subject is put before your readers, and here as a *first instalment* of those opinions I give below what my experience of 15 years stay in different *sal* forests has taught me in respect of fires in *sal* forests.

My views are that unprotected *sal* forests are less injured by fires than protected ones In protected forests we prolong the *fire season by artificial controls.* The public *generally* knows which forest to avoid, so the earliest fires catch the unprotected forests only, and late fires fall to the lot of our reserved areas. A late fire is hundred times more injurious than early fires, so where young growth in an unprotected forest escapes with a mild scorching the fire in our closed forests, if it comes at all,

plays havoc; because by successful protection for some years we not only make our younger regeneration tender, rather the accumulation of dead grass, weeds and leaves increases the intensity of the flame, so in a protected *sal* forest though we may feel satisfied with temporary good results our labours are sometimes entirely wasted when something unforeseen occurs. Thus in a protected *sal* forest what we achieve temporarily with great expense in a short time, is achieved more permanently in open forests without cost in a very long time. The early fires we know never burn the forests completely. They create patches, and these patches afford protection to each other against subsequent fires by seggregation. If therefore in an open forest some patches escape fire in any one year, the tiny young seedlings there at once find an opportunity to grow one step further; so in series of struggles they go on fighting with mild fires, and putting on new growth the year they escape the fires and remaining stationary or falling behind in growth the year they get a bad scorching. Thus we may find in an unprotected *sal* area a young *sal* four feet high in twenty years time, while in a protected area we may find it grow to that height say in four or five years time only. By giving such a good growth to *sal* seedlings we are lulled into belief that fire protection does wonderful good to the forest, but we do not count our gains and losses, and do not compare them with our neighbours who each year give a mild dose of fire to their forest, and thus keep their forests clear of all combustibles and more sanitary. I know of an Estate with extensive *sal* forests which were in lease to a Calcutta firm for over sixty years, and as the Lessee under the terms of his lease could deal with the forest in any way he liked, there was excessive felling, heavy grazing and no fire protection. Naturally therefore there was a belief that by the time the lease ends there will be nothing left on the ground but inferior species for which there was no local demand. Contrary to this expectation, however, when I visited these forests last year I found, all places I visited, beautifully covered with young growth of *sal*, and excellent regeneration. There was no fire protection there, and by the time the fire patrols in other places were anxiously

busy with their tasks these forests had already one sweep of fire over them. This is a living example, and I think those who know of other similar cases will see for themselves if this is an exception, or it confirms my point of argument.

From all the cases within my knowledge and experience I conclude, that fire protection is only necessary to give the young *sal* seedlings a start in life, but it is not necessary that you should adhere to fire measures beyond that stage. If soil conditions are favourable regeneration can be established by artificial early fires even, but if soil conditions are not favourable neither fire protection nor early fires can help much. Anyhow I advocate that protection of young seedlings should be consistent with general conditions of forest life in that locality. We should not introduce a novelty in their life and should not make them unnecessarily tender; we should only help the most needy young growth by saving them in small patches, and that too for short time, and then leave them to themselves to fight their way in the natural struggle with fires. My observations further confirm me in belief, that it is only fire that has given us pure teak and *sal* forests as they stand the fires better than other species, so this very fact is in favour of no fire protection for this class of forests. We know that our neighbours in Nepal have ideal *sal* forests and as they have brought them up without any fire protection we should not hesitate to throw our lot in with them. If fire protection would have been the only means to secure best results, the forests of Nepal we so much admire, would have been merely a heap of ruins without any regeneration on the ground, but this is not the case; they retain their superiority under crude systems of management and no fire protection.

If on the face of such living examples we advocate fire conservancy on the lines of rigid exclusion of fires, we surely go into a programme of costly fire conservancy without a reasonable excuse for it.

BAKHSHISH SINGH,
Forest Officer,
Rajpore Soharia.

Bágaha,
Champaran.

[Some of the problems raised in the following article are dealt with in Mr. Nicholson's letter on page 450. Rigid fire-protection in *sal* forests is seldom advocated nowadays. There are probably forests in which protection is a permanent necessity, but there are others in which protection is required only for the establishment of existing regeneration. On the other hand burning is prescribed in many working-plans with the object of obtaining natural regeneration.

Uncontrolled fires are, however, quite another matter. In our next number we record the views of several writers on the question of damage by creeping fires and their effect on the quality of the stand.—Hon. Ed.]

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THE AERIAL SURVEY OF THE FORESTS OF THE IRRAWADDY DELTA.

In our June issue we referred briefly to the progress that had been made in the aerial survey of the forests of the Irrawaddy Delta. A more extended account of the work has subsequently appeared in the press, the substance of which we give below, *pending a first-hand account from the forest officers engaged in the field-work.*

The aerial survey under the direction of the Survey of India and Burma Forest Departments of 1,300 square miles of forests in the Irrawaddy Delta was undertaken in the interests of the Forest Department, which is defraying the bulk of the cost, in order to provide maps of the Delta forests, and also to supply information regarding the distribution of the different types of forests from which the Forest Department will be able to prepare stock-maps.

The air-photo portion of the work was carried out by Mr. R. C. Kemp, late Chief Inspector of Aircraft to the Government of India, assisted by Major Cochran Patrick, D.S.O., M.C., late R.A.F. as pilot, and Flying Officer J. Duward, lent by the R.A.F., as photographer. He used D. H. 9 aeroplanes converted to seaplanes according to his own design. The survey field-work was carried out by No. 18 Party, Survey of India, under Major C. G. Lewis, R.E., who has now moved from Rangoon to Maymyo to draw the maps ready for publication. The forest officers engaged on the preparation of the stock maps were Messrs. C. W. Scott, D.F.C. and C.H. Robbins, M.C., D.F.C., both of whom served with the R.A.F. during the War.

The field work consisted of three parts : the taking of photographs of the area from the air by Mr. Kemp's agency ; the fixing by No. 18 Party, Survey of India, of prominent landmarks on

the ground, such as bends in rivers, which could subsequently be recognised on the photographs, as the known distances on the ground between these landmarks provided a means of enlarging or reducing the photographs to the scale selected for the map; the comparison on the ground, by the forest officers, of the air photos and actual forest growth, in order to become familiar with the appearance of the different types of forests as seen on photos. These officers also flew over the ground noting the distribution of the types. The original photographs naturally vary in scale, according to the height of the aeroplane at the moment they are taken, as it is impossible to ensure an aeroplane always remaining at a constant height owing to the varying density of the air, with the result that the scales of the photographs vary to some extent and they have to be enlarged or reduced by photography to bring them to a common scale.

To cover the area of 1,300 square miles between 3,000 and 4,000 aeroplane photographs were taken and the usual working day involved a flight, of over 100 miles and a rise of 10,000 feet from the Monkey Point air station at Rangoon, to the scene of operations, 3 hours photographing, during which about 200 plates were usually exposed, and a return of 100 miles to Rangoon. The plates were then developed and prints from them pinned together, to ensure that they overlapped without leaving any gaps. Copies of all the photos were then handed over to No. 10 Party for the preparation of the topographical maps, and to the Forest Department for the preparation of the stock maps.

While this air photography was in progress, Major Lewis and his party were fixing by theodolite, the positions on the ground of large numbers of landmarks as previously described. Having fixed these landmarks and received the aerial photos No. 18 Party will now be employed in Maymyo until the autumn in bringing these photos to a common scale by re-photographing and fitting them into their correct position with regard to the landmarks, this process being termed "making the Mosaic".

The rivers, roads and villages to appear on the map will be inked over on the mosaic and transferred to drawing paper, on which the drawing and printing of names will be carried out in the same manner as on other Survey of India maps, so that, when published there will be nothing to distinguish these maps from others surveyed in the ordinary way. This method of surveying is not considered economical for scales of less than three inches to one mile.

Owing to the difficult and swampy nature of the ground the survey of these forests of 1,300 square miles area on the scale of 3 inches to 1 mile by ordinary land methods, would have taken three years to complete and would have probably cost nearly twice as much as by the aerial method now adopted. The spectacular part of taking the photographs from the air naturally appeals most to the imagination, and undoubtedly requires great skill both on the part of the pilot in keeping the aeroplane at as constant a height and course as possible and also on the part of the photographer in taking the plates without leaving the gaps.

On the other hand, it should not be forgotten that what is termed the interpretation of the photographs and making an accurate map from them also requires skill and experience and whilst the aerial-photo part has taken three months this is really only about a quarter of the whole time involved, as Major Lewis with his party has spent the same period in fixing landmarks on the ground and has now a further six months work ahead of him in Maymyo, whilst at least another couple of months will be necessary for the completion of the stock maps by officers of the Forest Department.

EXTRACTS.

THE RELATIVE IMPORTANCE OF PLANTATIONS AND IMPROVEMENT FELLINGS IN BURMA.

The great prominence which has been given to plantation work in reports during the past few years has tended to present a rather distorted picture of the activities of the Forest Department in Burma. It puts things in the wrong perspective. The general reader might well imagine, that the greater part of the reserved forests in Burma are being regenerated artificially by means of plantations. As a matter of fact, this is very far from being the case. In 1921-22 the area of new plantations was only 7,228 acres, and in the year under report 1922-23 it was 6,160 acres (9·6 square miles). How does this figure compare with the total of over 30,000 square miles of reserved forests? Obviously so inadequately, that some re-adjustment of ideas is called for.

For it to be correct to state that any given forest is being regenerated by plantations or by any other method, it is necessary that there should be a definite and adequate relation between the area dealt with annually and the mean age of exploitability of the forest. If the forest takes 100* years to grow, then one hundredth must be regenerated annually. How does this axiom compare with actuals in Burma? It may be assumed that progress will continue with plantations under existing conditions at the rate of about 10 square miles per annum. Difficulties in obtaining the necessary labour preclude the possibility of any substantial increase beyond this figure at present. The need for better organisation of effort also points in the same direction. Reserved forests cover approximately 30,000 square miles. Supposing, for the sake of argument, that half the total is unsuitable for regeneration by means of plantations, and carrying on with the idea of a rotation of 100* years, it will be seen that not less than

* One hundred years is simply taken as a round figure for purposes of illustration. The time actually required may be less.

150 square miles of forest must be regenerated annually by any given method in order to justify a statement that the forest as a whole is being regenerated by that method. Comparing this figure of 150 square miles with the actual in Burma of 10 square miles per annum, it is a fair criticism of our planting operations to state that under existing conditions they cannot possibly affect more than a small fraction (1/15th), of the total area, of forest suitable for them.

In giving prominence to the relative smallness of plantations it is not desired to run them down or to decry their value. During his service of 20 years in Burma, the writer has all along been enthusiastic for them. There is no wish to deny the fact that acre for acre, plantations will yield many times more timber than natural forests. It is also believed that the money put into the plantations will eventually show a satisfactory return when the plantations become ripe for felling. All that it is desired to bring out here is what a large part of the forests is left untouched by this method of regeneration. The question may well be asked what are Foresters in Burma doing with regard to this, the major part of their charge. The answer is Improvement Fellings and other silvicultural operations such as Creeper Cutting............

An annual report is not the place to enter into detailed discussion of the subject, but it is desirable that the interest of all Forest Officers in the Province should be quickened with regard to the silvicultural operations which go under the name of Improvement Fellings. The argument for them can be put in a nutshell. Our forests are of a mixed character. Valuable species such as teak, *pyinkado*, etc., grow mixed up with other species of little or no value. If fellings of teak for trade or other purposes go on steadily without corresponding fellings of the other species, it stands to reason that the proportion of the latter will increase. This is, in effect, what has happened for many years past in many parts of Burma. Teak has been heavily extracted, but there has been no demand for other species. From the commencement of scientific forest management it was realised that the balance could only be restored by going to the

trouble and expense of deliberately cutting back worthless secies and individuals. Unfortunately the area covered by the annual teak fellings was so great and the supervision required to see that money devoted to Improvement Fellings was wisely spent was so inadequate, that the belief became general that Improvement Fellings were a counsel of perfection and in practice of little real value. In consequence of this pessimistic view, although the prescriptions with regard to them find a place in the majority of the working plans, very little attention has been paid to them in recent years. It has been left for the Conservator, Working Plans, to draw attention to this grave defect in our management and it is hoped that by the publicity herein given to the subject, steps will be taken to remedy matters. Division of forests into felling areas so that extraction may be limited to definite localities may go a long way towards the maintenance of a future supply of timber. The intervals of rest thereby given to particular blocks of forest do undoubtedly result in an increase in the stock of timber on the ground. Teak has such wonderful reproductive power that it may be able to hold its own and even to increase in quantity in spite of the fellings for extraction purposes, but if it is not assisted by Improvement Fellings, it is obvious that the forests of the future will not be as rich as they would otherwise be. The same remark applies to other valuable species............

The term "Improvement Fellings" connotes a great deal. It may be applied in one place to the felling of big but inferior trees that interfere with the growth of other trees of more value. In another place it may be used to denote the cutting back of inferior trees,—large or small,—with a view to assisting regeneration of the more valuable species. In the first case the work can technically be classed as a cultural operation for the benefit of the existing tree crop; in the second case the object in view is the establishment of a new crop. To indicate which is meant without lengthy explanation the terms "O" Fellings (*i.e.*, for the sake of old trees) and "Y" Fellings (*i.e.*, for the sake of young trees) were invented a few years ago.

Improvement Fellings were carried out over the following areas in the year under review :—

	Acres.	Total cost. Rs.	Cost per acre.
"O" Fellings ...	25,580 (40 square miles)	7,748	5 annas.
"V" *Fellings* ...	11,935 (19 square miles)	3 225	4 annas.
Total ...	(59 square miles)	10,973	

This was rather better than in the preceding year (48 square miles), but both figures are miserably small and inadequate. Here is a rough calculation giving some idea as to what ought to be done. The girdling of teak for sale purposes is based on a round of 30 years, more or less. That is, fellings are to be repeated in any given locality at intervals of 30 years. This is a purely arbitrary figure. Improvement fellings should obviously be repeated not less frequently than the fellings for sale. Again let it be assumed that half of the total of 30,000 square miles of reserved forests is so remote, inaccessible or inferior that it may be left out of account, the area to be gone over annually with Improvement Felling works out at $\frac{15,000}{30} = 500$ square miles, or ten times what we do at present.

Perusal of the "Note on the Pegu-Yoma Forests" by Mr. Watson, cannot help but convince anyone that the old belief in Improvement Fellings was perfectly sound, and that these operations ought to be given a very prominent place in silvicultural work for the enrichment and regeneration of the forests of Burma. In stating that we ought to do ten times as much as we do at present, the writer is not suggesting anything that is impracticable. It could be worked up to in a very short time. The crux is not lack of staff to supervise the operations, but funds with which to carry them out. Instead of Rs. 11,000 (as in 1922-23) over a lakh and a half of rupees would be required annually.

The above calculations make no pretence to being exact; they are chiefly intended to be illustrative. No one is in a position to dogmatise over details, even if he wanted to. The frequency and intensity of the Improvement Fellings, Forest Officers may still find occasion to argue about. All that can be

said at present is that the operations make trees grow faster and increase the number of useful ones per acre, but it cannot be said with certainty at present what the resultant increase in the annual yield of valuable timber will be, and so no reliable estimate can be given of the return to be expected from the money spent. It rests with the people of Burma through their elected representatives to say how far they are prepared to back the Forest Department in such an investment for the future.—[*Report on Forest Administration in Burma for the year* 1922-23.]

Fig. 1. The Power Pressing Mill with a pair of Ruston Presses.

POWER ABSORBED PER DAY. 30 Coolie units, 1 Fireman, 1, 3rd Class Engineer, and 8 B. H. P. from small portable steam engine, consuming $1\frac{1}{2}$ khandies of wood fuel per day.

OUTTURN PER DAY OF $8\frac{1}{2}$ hrs. 600 bales weighing about 100 lbs. each.

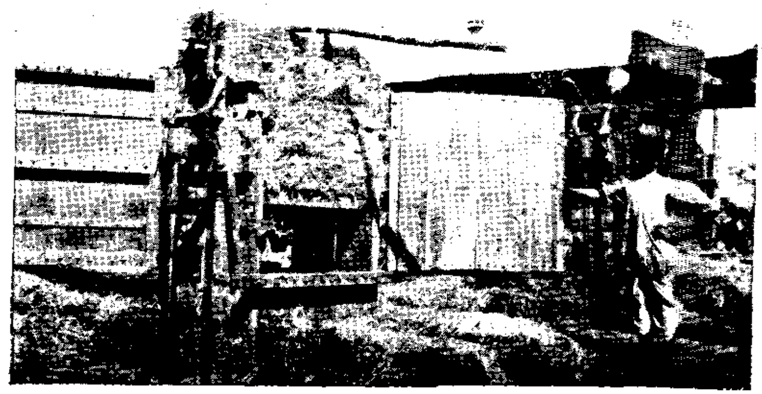

Fig. 2. A Hand Press adapted to working with Power.

POWER ABSORBED PER DAY. 5 Coolie units, and about 4 B.H.P. from a steam engine.

OUTTURN PER DAY OF $8\frac{1}{2}$ hrs. 45 bales ($4\frac{1}{2}' \times 2\frac{1}{2}' \times 2'$) weighing nearly 225 lbs. each.

Fig. 3. Temporary storage of grass for checking pending removal to the permanent storage sheds. One Karkun with a pair of coolies can weigh 600 to 800 bales in a day of 8 hrs.

Fig. 4. A line of storage sheds. The capacity of these sheds varies from 18 lacs to 20 lacs lb. in each shed.

Photos by T. K. Mirchandani.

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HOW BOMBAY INSURES AGAINST FODDER FAMINE.

The greater part of the Bombay Presidency, excluding Sind, depends for its food supply on the south-west monsoons, that happily invade this presidency from the beginning of June to the middle of October each year.

In years of defective or irregular monsoons, the Gujrat and the Deccan plateau (excluding the areas commanded by the Deccan Irrigation schemes), are the localities liable to that much dreaded occurrence the "Indian Famine." The shortage of food supply for human beings is almost always accompanied by shortage of the fodder supply for cattle and the other useful domesticated animals which are necessary for the agricultural and domestic economy of the ryots. The protection of the cattle and specially the milch and agricultural cattle is nearly as important as the protection of human lives in the affected areas.

The Famine Relief Department of the Government of Bombay have devised a general scheme for coping with the shortage of fodder wherever it may happen in the Presidency. The main principle of the scheme is to purchase every year fresh dry fodder grass, to the extent of several crores of pounds, pressed in suitable bales, and store it in godowns specially constructed for that purpose. The amount of grass purchased and stored each year varies from *year to year according to the budget allotment*, sanctioned for the purpose by the Legislative Council, for that year.

At present the purchasing depôts, with their pressing mills and storage sheds are distributed as follows:—

(1) Godhra } in Northern Gujrat.
(2) Dohad }
(3) Navapur } in Southern Gujrat and Western Deccan.
(4) Palghar }

The grass purchased in one year is stored up to 3 years and sold to the authorities distributing fodder in famine areas at any time that it is required ; or else after it has been stored for three years, it is sold in the general grass market when not required for famine purposes. Thus at any one time there is one to three years' store of grass in hand (excluding the current year's supply) to cope with an emergency like the wholesale failure of the monsoon over large tracts of the country.

This storage of grass for periods up to three years entails certain losses, *e.g.*, shortage in weight, destruction of grass by fungoidal or insect attacks, losses due to sales in the general grass-market, loss of interest on capital investment, etc.,—these charges being in the nature of an insurance fee against fodder-famine during the year.

The grass stored is pressed by steam power presses into bales of $3\frac{1}{2}' \times 17'' \times 23''$ = nearly 9 c.ft., weighing nearly 90 lb. each. The present price at which grass is pressed and stored is Rs. 12 per 1,000 lbs. free delivery in our storage godowns, and free delivery on rail in case of famine. The present selling price for Famine Relief is Rs. 16 per 1,000 lb. free on rail.

The contractors for this work are given facilities for cutting grass in Government lands. They have been allotted plots for the purpose in the Reserved Forests and the village *gurcharans*. Under agreement they are bound to bale a certain quantity of grass fixed for each of the above-mentioned supply stations. But it is optional for the Government to purchase any quantity *under* the above figure, after giving timely notice of the same to the contractors. Any grass in excess of Government requirements collected by the contractors from Government lands is allowed

royalty free to the contractors. Most of the storage sheds are wooden structures covered with galvanised corrugated iron sheeting. From last year the Forest Department has started constructing more permanent and economical masonry and steel structures. One such shed has been built at Dohad and one at Godhra. At present one all-steel storage shed is under construction at Palghar.

It has been worked out that the new sheds are more economical in cost of storage per lb. than the previous structures.

The whole of the administrative work of this part of Famine Relief is carried out personally by the Chief Conservator of Forests, Bombay Presidency, through the co-operation of his executive staff in the districts

T. K. MIRCHANDANI.

THE INCREASING POPULARITY OF *BAKAIN* IN THE PUNJAB.

For many years the natural seedlings of *bakain (Melia Azedarach)*, which appeared in the irrigated plantation of Changa Manga, were ruthlessly cut out as a weed, but in spite of this treatment and the constant damage done to the coppice shoots by nilgai, it has apparently "come to stay." Although a short-lived species, its growth during the first 10—12 years is very much faster than either *shisham* or mulberry in Changa Manga, in fact, *unless it occurs in groups of pure bakain it* develops as a wolf-tree, becomes branchy and also grows many burrs bearing epicormic branches. It has replaced the mulberry in many places which were starved of water during the dry years of 1920-21, and is thus a more reliable species for irrigation work when the water supply is unreliable.

During the war years it was sold as logs and as firewood when it occurred in the fellings, and during the last year it was sold in the Changa *Manga auctions at a steady price averaging* Rs. 1-1-8 per cubic foot for small logs. Its chief uses in the Punjab so far appear to be for light furniture, packing-cases, and shelving, though as it becomes better known many other uses should be found for such a light strong wood. It is apparently

being taken up for planting in Australia as a suitable wood for packing-case work, and this is probably its best field of development. Its value as a firewood compares favourably with that of mulberry.

From a sylvicultural point of view it regenerates best under a light shade and develops later as a light demander. It is useful as a nurse-tree for more delicate species, and a group of four-year-old *bakain* has been found invaluable in the forest nursery in Daphar irrigated plantation in shielding seedlings of *Eucalyptus*, *tun*, and fruit trees from the scorching afternoon sun. In the canal colonies throughout the province one sees that the cultivators have appropriated this species as an easy means of growing shelter for themselves and their cattle, for there are many small clumps of two or four-year-old *bakain* growing apace around their huts.

R. M. G.

STRYCHNINE IN SANDAL.

During the course of my inspection of the enumeration of sandal trees in the northern part of Mysore, I came across a few sandal trees growing near trees of *Strychnos Nux-vomica*. As this was a host plant I had not met with before, I examined the root-connections, half-expecting that it might turn out to be a bad host, as it is closely allied to *Strychnos potatorum*, the roots of which I have found to be nearly immune to the attacks of the sandal haustoria. But the roots of *S. Nux-vomica* were extensively attacked and the woody cylinder penetrated in most cases, the haustorial cushions being medium to large in size. In addition, all parts of these sandal trees including the leaves, bark and wood, were intensely bitter to the taste, similar to that of the host-plant. This strychnine imbibed from the host-plant appeared to have no ill-effect on the sandal trees, as they were all vigorous and healthy. Specimens from these sandal trees have been sent to Dr. Coleman for investigating the percentage of strychnine present in different parts of the tree.

This case serves to question the existing theory that sandal takes only the crude sap from the host-plants. In the case of sandal and *S. Nux-vomica*, it is certain that the sandal has absorbed some organic substances from the host in addition to the crude sap. This may be explained in two ways, (1) that the sandal haustorium may also function in the absorbtion of the elaborated sap from the host-plants or (2) the haustorium may absorb the disintegrated products of bark and wood during the act of penetration.

The first theory may be supported by the fact that in all cases a certain percentage of the haustoria extends only as far as the cambium and never reaches the woody cylinder of the roots of host-plants. It is quite possible that these haustoria may function only as absorbers of the elaborated food materials or they may be abortive cases where the normal development of the haustoria has been interfered with. The second theory is more rational and may be assumed to be correct. In *S. Nux-vomica*, strychnine is found deposited in both the bark and wood, and the sandal haustorium must have absorbed it during the process of penetration.

This theory has an important bearing on the investigation of the spike disease in sandal. The sandal haustoria after it has ceased to function, leaves large open sores on the roots of host-plants. Considering that the sandal tree has a superficial root system, and that the bulk of its haustorial attacks on the roots of host-plants are found within a few inches of the soil-surface, it is obvious that any kind of infection from the soil will find suitable lodging in the numerous gaping wounds left by the haustoria—and I have several times come across, bacterial and fungoid growths in such wounds. The infecting virus may spread into the root or remain localised in the wound itself, but in either case, the sandal haustorium may absorb the poison, as new haustoria attacks often overlap old wounds, and the products of disintegration of wood and other organic matter met with are absorbed by the haustoria. The sores left on the roots of host-plants by sandal haustoria take a much longer time to heal than ordinary

bruises or cuts and hence are exposed to infection for a longer time. In the light of the above remarks, and the existing literature on the subject of the spike disease in sandal it may be presumed that the main channel of infection of the disease lies through the roots of host-plants.

The above inferences have been drawn on the basis that *spike disease in sandal is infectious.* It is the only rational theory that has stood the test of experience. It is a pity, that the theory of the unbalanced circulation of sap has led some of the investigators astray, and the sooner it is given up, the better it will be for unravelling the mystery of the disease. It is not perhaps generally known that the major portion of Mysore State is still free from the disease. If a straight line is drawn due east from the northern limit of Coorg, it cuts off all the spiked areas in and out of Mysore to the south of it. All country to the north of this line is still absolutely free from spike disease. About two-thirds of the Mysore State which includes the bulk of the sandal bearing areas in the State lies above this line, and no spike disease is found anywhere in this area though it presents a considerable variety of climate and the rainfall varies from about 300 inches on the Western Ghats to 24 inches in the eastern districts. If the spike disease is due to unbalanced circulation of sap, disease would have been found sporadically all over the State in places where the contributory causes are much in evidence. During the past five years I have been engaged in supervising the enumeration of sandal trees in the northern half of the state for the compilation of sandalwood working plans, and every day come across sandal trees, subjected to all conceivable kinds of injury and mal-treatment and yet not a single tree shows any signs of spike disease. About two thousand square miles of country have been traversed so far and over twelve lakhs of sandal trees enumerated out of which about sixty thousand trees are in dying state, most of them due to severe fires, destruction of host-plants and to the mal-treatment of the tree itself, which though considered the main causes which bring about the unbalanced circulation of sap, have not been able to cause the spike disease in a single instance.

I would like to suggest to the believers in this "unbalanced" theory of the spike disease that they should undertake an extensive tour in the northern half of the State and find out why the factors which are said to bring about the unbalanced circulation of sap, fail to cause the spike disease in sandal in the huge sketch of sandal areas extending over eighteen thousand square miles.

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Sub-A. C. F., Mysore State.

PARROTIA JACQUEMONTIANA FOR USE AS HAMMER HANDLES.

The investigation of *Parrotia jacquemontiana* for use as hammer handles was suggested by a query from the Divisional Forest Officer, Lower Hazara, and the work was begun on material supplied by him.

The investigation was divided into two parts, one a series of tests in static and impact bending of small clear specimens as near to standard size as this small timber would furnish, to use as a basis of direct comparison with American hickories and ashes, which have been tested in the United States by Standard methods, and second a test of a number of made-up *Parrotia jacquemontiana* handles to use as a basis of comparison with *Olea ferruginea* and other Indian woods already tested in the same manner.

The first series of tests mentioned above were made as soon as possible after the receipt of material, and it was possible therefore to test the material in a practically green condition. The advantage of this is that it makes the comparison with American species absolutely reliable, all the timber having been tested under the same conditions. Table No. I is a summary which shows the average strength values of the different species concerned.

TABLE No. 1.

	Moisture content	Specific gravity.	Transverse Strength.		M. of E. in 1,000 lbs.	Work to E. L.
			F. S. at E. L	F. S. at Max. load		
Parrotia jacquemontiana. ...	32 5 %	·694	3,867	9,425	1,069	·73
Ash, biltmeren.	42 %	·51	5,500	9,300	1,340	1·31
Ash, black. ...	83 %	·46	2,600	6,000	1,020	·42
Ash, white. ...	43 %	·52	4,900	9,100	1,350	1·03
Hickory bitternut.	66 %	0·63	5,500	10,300	1,400	1 22
Hickory mecker-nut.	59 %	·64	6,300	11,100	1,570	1·38
Hickory nutmeg.	74 %	·56	4,900	9,100	1,290	1·06
Hickory pecan.	69 %	·60	5,200	9,800	1,370	1·18
Hickory pignut.	54 %	·66	6,200	11,700	1,650	1·34
Hickory shagbark	60 %	·64	5,900	11,000	1,570	1·28
Hickory shellbark	61 %	·62	5,600	10,500	1,340	1·36

For the second series of tests mentioned above the material was seasoned and made up into hammer handles of the same type as were formerly used in tests of *Terminalia tomentosa, Dalbergia sissoo, Olea ferruginea* and other timbers. Although it would be preferable to compare the strength of these timbers on the same basis as the results presented in Table No. 1, this is impossible because such results are not yet available for these timbers. For this reason Table No. 2 is prepared, which will give a direct comparison of the species in question when actually tested as hammer handles. Table No. 2 presents these results.

TABLE NO. 2.

Species.	Moisture % of weight of drywood.	Static Bending.		Impact Bending.	
		Fibre stress at elastic limit pounds per sq. in.	Modulus of rupture pounds per sq. in.	Fibre stress at elastic limit pounds per sq. in.	Height of drop of 50 lb. weight causing failure.
Terminalia tomentosa.	12	13,315	18,980	35,670	9·77 in.
Dalbergia Sissoo ...	12	11,000	17,770	37,380	12·87 „
Parrotia jacquemontiana.	12	12,325	21,430	26,085	7·4 „
Anogeissus latifolia	12	10,590	20,735	32,875	8·2 „
Schleichera trijuga	12	8,445	17,260	35,005	8·0 „
Olea ferruginea ...	12	8,000	21,460	35,180	9·3 „

In the case of axe helves, hammer handles, and similar tool parts which are subjected, as a rule, to a sudden strain but are not called upon to carry sustained loads the fibre stress at maximum load, (modulus of rupture), is of more importance than the fibre stress at elastic limit. Considering table No. 1, it will be seen that in both fibre stress at elastic limit and fibre stress at maximum load *Parrotia jacquemontiana* compares favourably with the American ashes and hickories, while its comparatively low modulus of elasticity renders it, if anything slightly less liable to breakage than the American species. It should, therefore, make a satisfactory axe helve wood and at least be well worth trying for the purpose.

Considering also table No. 2, which presents the results of tests made on handles of seasoned wood from specimens containing the same amount, namely, 12 per cent. of moisture, it will be found that *Parrotia jacquemontiana* gave extremely good results. Its lowest value was in impact bending, but it must be pointed that the number of tests of this particular nature was small, and that material available for these tests, after the other tests had been finished, was of rather inferior quality. The

indications are that *Parrotia jacquemontiana* should be at least as good as, if not better than, *Olea ferruginea*, which has already proved a satisfactory tool handle wood in practical use.

Combining the results of both tables and considering them in the light of notes made on the nature of the material and the nature of the failures during the tests, it is considered that *Parrotia jacquemontiana* will be found to make a very satisfactory wood for axe helves, hammer handles and the like.

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L. N. SEAMAN,
O.-i.-C., Timber Testing.

THE UNEXPECTED EXTENSION OF AN UNDESIRABLE TYPE OF FOREST.

In the locality to which the following remarks apply are several different types of forest such as—

(1) Pure or nearly pure *sal* forest.

(2) Pure or nearly pure bamboo forest.

(3) Bamboos mixed with miscellaneous species, *i.e.*, *Terminalia tomentosa*, *Adina cordifolia*, *Anogeissus latifolia*, etc.

(4) Type 3 *sal*. Bamboos are somewhat less than in 3.

(5) *Bambusa arundinacea* either pure or mixed with miscellaneous species.

These are the main types, but the growth varies so much that it is quite easy to classify each of these types to two or three sub-types. For the purpose of this note we are concerned only with type No. 4. This type consists of scattered *sal*, *Terminalia tomentosa*, *Adina cordifolia*, *Anogeissus latifolia* and other species, which are not utilised at present—mixed with *Dendrocalamus strictus*. Though this bamboo is fairly common in this type of the forest it is not so abundant as in type No. 3, nor has it been able to make much headway against the tree-growth as it has done in type 3. The growth of *sal* and other species is quite good. The Working Plan which expired two years ago prescribed the usual selection and improvement fellings

for part of the area and improvement fellings only for the rest. In certain portions where the stock appeared to be good twenty years ago, *sal* trees were enumerated while in the rest of the area which appeared to be poorly stocked with *sal* no such enumerations were carried out. In the former a fixed number of *sal* trees over a certain girth were to be felled annually, while in the latter no fixed number of trees was prescribed, but it was simply laid down that fellings were to be done by area. In the former case marking was to be done under Selection and Improvement method, while improvement fellings only were prescribed for the latter. A set of marking rules, mainly for regulating the marking of *sal* was given in the Working Plan. Though it was laid down that *sal* should be given preference to all other species and the *sal* area further extended, no definite proposals were made to attain that object. As there was and is still no great demand from these forests for *Terminalia tomentosa*, *Adina cordifolia*, etc., it was not thought worth while to lay down any definite lines on which these species were to be treated. It was however implied in the Working Plan that trees other than *sal* should also be removed if there was any demand for them, and also to generally improve the *sal* crop.

Under the selection method only *sal* trees were marked, while all sorts of trees, removal of which was considered necessary to improve the stock, were marked under the improvement method. In the area where enumerations were done there was a very large number of *sal* trees both young and mature. As it was definitely laid down that a certain number of *sal* trees must be marked annually, there was no alternative for the marking officer but to carry out this order. It has already been pointed out that there was little or no demand for trees other than *sal*—especially from the interior on account of heavy transport charges— and as there was no obligation to mark any trees except *sal* under selection method, the marking officer, after he had marked the total number of *sal* trees prescribed in the Working Plan, either declared the marking to be over or sometimes marked a certain number of miscellaneous trees, merely to show that some trees have been marked under improvement method also. The coupes

thus marked were auctioned annually. The purchasers regulated their bids according to the number of *sal* trees marked in each coupe ignoring all the other marked trees altogether. This method of marking and the disposal of coupes has now gone on for fifteen years.

A word might also be said about the way the trees were disposed of before the Working Plan was put into force. It is an admitted fact that the nature of rules and regulations for the disposal of trees depends a good deal on the demand. If the demand is slack these rules have to be very liberal and if it is altogether absent and has to be created, then at times it becomes necessary even to go against sylvicultural requirements. Twenty to thirty years ago such were the circumstances in Angul, that special messengers had to be sent to induce the purchasers to start timber business in these forests. No local people were available. After a good deal of hunting a contractor from outside was found agreeable to work in these forests at that time described as the most inaccessible in the whole of Bengal. He was given a free hand to select trees for felling in a particular locality, which had to be in the vicinity of the main line of export. As was to be expected this purchaser would not look at anything except *sal*, and, when any of the trees selected was found out to be hollow or defective after felling, a substitute was given. This went on for several years.

Sometimes "dry" *sal* trees were sold in a compartment after the main fellings had been completed. These trees were selected by the purchasers themselves and then marked by a subordinate. Some of these trees were actually dry, but all those trees about which there was some "doubt" as to whether they were "dry" or not were also taken as dry and not unfrequently they were really green.

As the revision of the Working Plan is in progress it is an opportune time to see whether the objects of management, *i.e.* the preference of *sal* and the further extension of *sal* area have been attained in Type No. 4 forests :—

1. *Areas subject to selection and improvement method.*

If a trained forester who was here fifteen years ago was to come back to-day, he will not take long to notice the transforma-

tion these areas have undergone during his absence. He will find that the proportion of bamboos to tree-growth has increased. The thing he will miss most is *sal*. The purchasers have felled most of the marked *sal* trees—leaving only unsound ones—and left most of the marked miscellaneous trees standing. There was no obligation on the part of the purchasers to fell all the marked trees, so they removed only the best of the *sal* trees and left everything else standing. The result of all this has been that most of the area which was type No. 4 fifteen years ago has now become type No. 3. In other words the Forest Department with the willing assistance of the purchasers has converted a forest containing *sal*, miscellaneous species, and bamboos to a forest containing miscellaneous species and bamboos. The value of these forests in this particular locality depends upon the presence of *sal*, and both these parties have helped one another to eliminate it from a portion of this division. Whether this result had been foreseen in the beginning or not it is not clear; the Working Plan shows no indication that it had been. If it was, then an addition of one simple clause in the standard High Forest Agreement, namely, that all marked trees must be felled by the purchasers would have helped to preserve the chief characteristics of these forests. This clause would have compelled the purchasers to fell all the marked trees whether *sal*, *asan* or any other. If they failed to comply with this condition, then the department would have undertaken the felling of the marked trees left by the purchasers and charged the latter the expenditure incurred. This condition has now been introduced and it is hoped that it will have the effect of preserving type No. 4 and at the same time extending *sal* area.

2. *Areas subject to improvement fellings only*.

The main object here was to improve the stock. As there was very little *sal* in this area and the soil so unsuitable for it that extension of the *sal* area was neither practicable nor desirable; and though the Working Plan did not say so clearly it was implied therein. For the same reason as given above the purchasers removed the best of the marked trees and left all the unsound marked trees standing. One could imagine the condition of the

crop after 15 or 20 years of work on the above method. The result has been absolutely the opposite of what was desired. While at the start there was a very large number of sound and straight trees which outnumbered the crooked and unsound ones, now after twenty years of work the proportion of the latter class of trees has actually increased.

In conclusion, I must make it clear that the above lines have not been written with a view to criticise the past management. The conditions in this locality were such that no better system could have been adopted. As a matter of fact great credit is due to the past Forest Officers, who made strenuous efforts to induce the people to start timber work here at the time when everybody except perhaps the forest staff was afraid to visit these jungles on account of their being inaccessible and unhealthy. Unless special facilities were allowed, as they were, to the purchasers, there was no hope of exploiting these forests at all.

L. R. SABHARWAL, I. F. S., B.Sc.

THE IMPERIAL FORESTRY INSTITUTE, OXFORD.

The present year will see the beginning of what should prove to be a great development in Forestry training and research, with the establishment at Oxford of an Institute which will be known as the Imperial Forestry Institute, a title adopted at the command of His Majesty the King.

The question of establishing a central training institution was first discussed by the British Empire Forestry Conference in 1920. This Conference felt that, owing to lack of funds and dissipation of effort, training in the higher branches of forestry for the needs of the Empire was nowhere as complete or efficient as was desirable, and therefore recommended the establishment in the United Kingdom of one institution which should undertake the higher training of forest officers and should also be a centre for research into the formation, tending, and protection of forests. An impartial Committee, consisting partly of representatives of Government departments concerned and partly of experts, was thereupon appointed to make recommendations regarding the

location and organisation of such an institution, and other matters. After visiting the Universities of Oxford, Cambridge, Bangor and Edinburgh, and also taking evidence from other Universities, as well as from Institutions and Societies interested in forestry, this Committee issued in 1921 a report, which recommended the establishment at Oxford of a central institution for the higher training of forest officers, for training in research, for the provision of special and 'refresher' courses for officers already serving, and for the conduct of research into forest production. The report made it clear that there was no intention of interfering with the work done by the various University Schools of Forestry, and, provided the training of these was maintained at a required standard, selected students from any such schools would be eligible for admission to the central institution. Full details will be found in the Report of the Inter-departmental Committee on Imperial Forestry Education, 1921 (Command Paper 1166).

Further action was suspended until 1923, when the proposals of the Inter-departmental Committee were considered by the British Empire Forestry Conference in Canada. The Conference supported them in the strongest terms, and they were subsequently endorsed by the Imperial Economic Conference held in London the same year. Arrangements have accordingly been completed for starting the Institute in October 1924.

The Imperial Forestry Institute will be a University Institution, the Professor of Forestry being its Director. It will be under the control of a Board of Governors representing the University and Government Departments concerned, under the Chairmanship of Lord Clinton, a Forestry Commissioner. The educational work of the Institute will comprise (1) post-graduate training of probationers for the forest services and of other qualified persons, (2) training of research officers in special subjects and (3) provision of courses for selected officers already serving. It is intended that the Institute should maintain close touch with and be of assistance to the various forestry training centres throughout the Empire. Thus, in the case of overseas training centres which have no direct means of giving practical instruction in the latest systems of management as practised on the continent

of Europe, it will be one of the functions of the Institute to arrange for such practical instruction to be given by members of its own staff to students who have already completed their general course of training at their own Universities or Colleges.

If in any particular case it cannot undertake to give direct instruction, the Institute may arrange that this should be given at some other place. It is proposed, for instance, that close touch should be maintained with the Royal Botanic Gardens, Kew, whose unrivalled resources should be of great assistance to those students who may wish to study systematic botany and economic products. Again, forest engineering is a subject which cannot be dealt with comprehensively in Great Britain, owing to the absence of logging operations on a large scale; arrangements will therefore be made as far as possible to study it practically in the forest regions of the Continent, or in certain cases in Canada. Similarly, the study of tropical silviculture from the practical point of view is impossible outside the tropics, and hence the Institute will maintain close touch with other institutions where this subject can be efficiently dealt with, such as the Forest Research Institute and College, Dehra Dun, in order that the best possible arrangements may be made in the interests of students who wish to make a practical study of tropical silviculture.

Although the Institute is intended primarily to serve the needs of Forestry in the British Empire, it will be open to qualified students of any nationality provided that there is sufficient accommodation. Nor is it by any means intended that it should cater only for the requirements of State forest services; now that timber and wood-pulp firms are becoming more and more interested in the management and working of forests on scientific and economic lines, the Institute should be of special value in providing them with fully trained employees. Students admitted to the Institute may, in fact, be included under any of the following categories :—

(a) Those possessing a Degree in Forestry, or a Diploma or equivalent certificate of having satisfactorily completed an approved course of training in forestry, who have been selected as probationers for the higher branch of some forest service.

(b) Graduates with honours in Science, who desire to become specialists in some branch of work connected with forestry.

(c) Forest officers deputed to attend courses with the view of bringing their professional knowledge up to date.

(d) Students of approved qualifications not included in the first three categories, who are admitted on the recommendation of overseas governments.

(e) Students with a University training in forestry who may wish to attend the Institute on their own account and at their own expense.

The course of study at the Institute will normally extend over one academic year, beginning October, and will be made sufficiently elastic to serve the needs of individual students. The subjects dealt with will cover the whole range of Forestry, and will include Silviculture (European and Tropical), Forest Management (including Mensuration, Valuation, and Working Plans), Forest Botany (including physiology and anatomy of trees, mycology and pathology, ecology and systematic botany), Forest Zoology (including entomology), Forest Utilization (including the structure, properties, and uses of wood), Soils, Climatology, Forest Economics and Policy, Forest Law, and Forest Engineering including Surveying.

Temporary accommodation for the Institute has been arranged, but a more suitable site and larger buildings will be necessary, and the formidable task of obtaining funds for the acquisition of a site and the erection of buildings will fall on the University. The requisite sum for this purpose will be far beyond the means of the University to provide, but a building fund is being started, and it is hoped that this great undertaking will not suffer from lack of support on the part of benefactors who have at heart the welfare of the Empire in general and the cause of Forestry in particular.

THE EMPIRE FORESTRY ASSOCIATION.

In the July issue of this journal there appears a lengthy account of the progress of this Association, and the impression

conveyed is that the society has now been established on a very sound foundation everywhere except in India.

Since the creation of the Association in 1920 the *Indian Forester* has published notices of its activities. Nothing however appears, as yet, to have been initiated for the benefit of this country.

That the people of India are not wholly without interest may be seen by a reference to the list of members, which includes a number of our princes and other Indians. Some action had been anticipated from Dehra Dun, but an enquiry reveals the fact that it has been expecting inspiration from above, and it appears that the formation of an Indian Forestry Association had actually been contemplated with a view to eventual affiliation with the main Empire institution The idea appears to be an excellent one. India is sufficiently large to support its own society while in matters of forest organisation, management, research and education it takes pride of place in the Empire. For political reasons alone the creation of an independent body is urgently required, as the legislators and the masses both require constant and energetic measures to ensure a correct realisation of the part taken by forestry in the domestic economy of the country.

It has been seen that already in one province a local clamour, aided by incendiarism, has resulted in the reversion of a policy, which aimed at the preservation of forests reserved for direct benefits to the local population and indirect benefits to the country at large. There is nothing to prevent a similar agitation arising almost anywhere, and the corrective lies in a well-informed public opinion, which alone can effectively suppress agitation not based on a correct appreciation of facts conected with forests but upon a selfish disregard of all consideration for others.

It must be remembered that the policy of forest conservation was imposed on the country at a time when public opinion was inarticulate or non-existent. A natural reaction has now set in against all enactments, however beneficient which were thus, autocratically brought into force. An unofficial organisation is therefore the best means of overcoming administrative difficulties

particularly in this country, wherein all political creeds are allied against the Government. The opportunity afforded through an Association to official and non-official elements of meeting on a common basis cannot fail to be of mutual benefit to both parties. There can, therefore, be no question of the desirability, or indeed necessity, of India organising a body which can bring into prominence the interests to the country and to its people of the maintenance of the forest estate,—an estate which covers nearly a quarter of the area of the country. A free discussion of all problems, aiming at the welfare of the people, can only lead to a better understanding, while the departmental and technical staff have an obligation in making known all facts which will induce others to realise the valuable nature of the forests and their products, not omitting to reveal such efforts as have been or are being taken to develop the resources of the forests to their maximum. Government can issue propaganda on its own, and already much literature is available, but it is evident that all attempts made in this direction are either too technical or are treated with suspicion and therefore fail in their object.

It must obviously be conceded that the creation of an Indian Forestry Association is desirable and it follows that there is no time like the present. The question then arises how to proceed. Clearly the send-off must be official and it is justifiable, in view of the public interest at stake, to spend money from public funds until such time as the Association can support itself and become independent. The suggestion is to place the matter in the hands of the head of the department, whose position at headquarters and whose influence with all concerned, should afford him special and unrivalled opportunities of performing this task. His functions have been much restricted, but he is still the principal link between the Government of India and Local Governments or even between Local Governments. His ability to tour throughout India also places him in the necessary commanding position, and he can therefore become the principal means of furthering this object. Much has been heard of the abolition of the highest post in the department, but if it be recognised

that it is part of the functions of the incumbent to influence public opinion in forest matters, and with that object inaugurate and firmly establish an Indian Forestry Association, there will be ample justification for the retention of the post for this object alone. Given the acceptance of this axiom the rest can be left to the energy and ability of the man elected to the highest prize the department offers.

YOUNG HOPEFUL.

I'd soo the beehole borer on to Beeson.
But sweltering in this rest-house chair I hate,
It's made my poor old base quite cuneate.
And now I think I'd best conclude my song.
The men at last have spliced the punkah thong.

MAKOMAKO.

THE BOMBAY FOREST ALPHABET.

(At 120° in the shade.)

A is an auction, where prices are high,
B is a Bidder, refusing to buy,
C, a Contractor, who cannot get carts,
D is a Depôt, where work never starts,
E is an Engine, gone *phut* in the Mills,
F is a Forester, lost on the hills,
G is a Grouse (a most flourishing bird),
H is a *Hookum*, which nobody heard,
I 's an Incendiary, idling around,
J is a Jungle, where insects abound,
K is a *Koonbie*, destroying the trees,
L is the Lack of the longed for rupees,
M is for *Murrum* (we've none for the road),
N is a Nullah, too steep for the load,
O 's your Opinion,—and no one wants *that*,
P, a Plantation,—where cattle grow fat!
Q are the Questions folk ask more and more,
R, the Reports you must write by the score,
S is the Scheme which you want to push through,
T is the *Takra* there'll be if you do,
U is the Utilisation of scraps,
V is the Village not marked on the maps,
W is Wifey, left lonesome and sad,
X is for Xmas,—so let us be glad!
Y is your Yell when your pay-bill you see,
Z—is a *Zizyphus Jujuba* tree

F. D.

THE GROWTH AND REGENERATION OF PINE FORESTS IN CALIFORNIA.

SOME RESULTS OF CUTTING IN THE SIERRA FORESTS OF CALIFORNIA, by DUNCAN DUNNING, U. S. Department of Agriculture, Bulletin No. 1176, November 24th 1923.

The object of the study resulting in this bulletin is to determine cutting methods for the Sierra Forests of California, that will secure adequate reproduction and retain desirable advance reproduction and immature timber for its growth after cutting. Four forest types were studied, namely, pure western yellow pine; yellow pine—sugar pine; mixed yellow pine—sugar pine, Douglas fir, white fir, incense cedar; and sugar pine—fir. Results are to be used as a basis for revision of marking rules and a building up of good "silvicultural practice" for that region.

Conclusions are based on periodic observations and measurements of 25 sample plots, totalling 300 acres and 13,000 trees, established in 1911 on National Forest cut—over areas in the Sierra Belt near Mt. Shasta. The plots were distributed over as many variables of site, type, and degrees of cutting as offered by the region and cutting methods in vogue at that time.

Dunning takes up first the growth of stands remaining after cutting and lists the influencing factors in order of their importance, as follows: "Site, species, size and age, crown size and form, degree of cutting." He has prepared tables showing growth per cent. as affected by variations of the above factors.

"On sites 1 and 2 a reserve volume is justified for increased growth and improved quality of second cut," but on site 3, or poorer, accelerated growth was in no case sufficient to justify reserving merchantable timber for this purpose, and cutting should aim to secure reproduction only.

"White fir ranks first in rate of growth, followed by sugar pine, Douglas fir, yellow pine and incense cedar. Sugar pine maintains a high rate of growth to a greater age and diameter limit than other species." The rate of the released growth was found to vary more in proportion to length of crown than to any other crown characteristic. It is interesting to note that Chapman found this to be the case in longleaf and loblolly pine of the South, and it seems probable that this may hold true in conifers of all regions.

The author brings out forcefully the rather elementary silvicultural facts that no acceleration of growth occurs in groups of trees after cutting where there has been no cutting in the interior of the group, or in open-grown stands where no competition existed before cutting. He states more specifically, however, that "no acceleration is observable unless trees are removed within 50 or 60 feet" of the tree reserved. The exact relation between degree of cutting or release and amount of accelerated growth seems to have been obscured by uncontrolled variables on the plots studied.

The discussion on reproduction emphasizes great necessity for taking all possible care to preserve reproduction already on the ground before cutting it, because of the difficulties and length of time involved in securing reproduction after cutting. These difficulties are attributed to "drought and infrequency of seed crops on poor sites," and on the better sites to competition with vegetative ground cover, insufficient opening up of the stand by

cutting, and infrequent seed crops. It is recommended that the present practice of piling and burning brush be abandoned, the contention being that burning results in "covering by fire of at least 6 to 10 per cent. of the area, on which a considerable number of seedlings and saplings are destroyed," and "that areas covered by fires are rendered unfavourable to establishment of seedlings for several years." Although the author admits that "exposure of mineral soils and openings created by fire favour yellow pine" he advocates that piling and burning of brush be dispensed with for the region as a whole. Pearson in the southwest recommends general piling and burning of brush in yellow pine type. Apparently the loss of yellow pine reproduction by burning brush in the Sierra region as a whole offsets any advantage gained by opening up seed beds of mineral soil.

In conclusion, figures are exhibited to show that after all, on areas devoid of advance reproduction, restocking by artificial planting would be less expensive than depending on natural reproduction, when all costs and values of each method are considered.

E. W. HADLEY,
Forest Examiner,
U. S. Forest Service.

THE NATURAL REGENERATION OF DOUGLAS FIR.

THE NATURAL REGENERATION OF DOUGLAS FIR IN THE PACIFIC NORTHWEST, by HOFMANN, J. V.; U. S. Department of Agriculture, Bulletin No. 1200, 63p., pl., maps, diagr, 1924.

A new Bulletin of the U. S. Forest Service covering the Natural Regeneration of Douglas Fir in the Pacific Northwest by Dr. Julius V. Hofmann of the Wind River Forest Experiment Station, has just been issued. (United States Department Agriculture, Bulletin 1200). In this bulletin the conditions that control the natural restocking of Douglas fir *(Pseudotsuga taxifolia)* orests after forest fires and after logging and slash-burning are analysed and the underlying principles are worked out for the first time. The studies conducted by the experiment station led

to new discoveries in the field of forestry that mark a new era in the management of the forests of the Douglas fir region of the Pacific Northwest and have been found to apply in other regions where they have been checked, such as in Canada, in the eastern United States, and in India.

The explanation of the dense stands of young Douglas fir growth after disastrous forest fires and after slash fires, and the barren areas where the land has been reburned, was found in the characteristics of the seed and the provisions of nature in insuring a supply of seed in the forest floor at all times.

It was found that Douglas fir seed retains its viability or eight years when stored in the forest floor, and many instances were found where the seed has lasted much longer. Large quantities of seed are stored in the forest floor after every seed crop and remain there awaiting the removal of the forest and favourable conditions for germination.

Where stands of young growth are destroyed by fire before they have reached the seedling stage, there is no source of seed and the restocking of the area depends upon the seeds produced from the nearest seed trees. For this reason a second fire causes barren areas.

Through relatively simple and cheap measures, it is possible for the lumbermen to insure a continuous supply of forest for their operations. The chief one is the prevention of fire after the slash has been burned over. Present cutting and logging methods need not be changed, although the methods of slash disposal should be systematised in order to insure the proper kind of burning and at the right time.

E. N. M.

EXTRACTS.

MEN OF THE TREES.

Wherein is told the remarkable story of the Forest Scouts of Kenya, formerly a band of African Warriors known as Forest Destroyers.

Who are the Men of the Trees, or the Forest Scouts of Kenya, as this body of Africans has now come to be known? They are a band of some thousands of warriors who inhabit the highlands of Kenya Colony, formerly British East Africa. This organisation originated among the Kikuyu tribe, who were locally known as "The Forest Destroyers" by reason of their shifting methods of agriculture. Whenever they wanted to make a fresh cultivation they went into the virgin forest, cut down and burnt off the trees, planted their seeds, and reaped two crops, after which they abandoned the old cultivation and proceeded to take up more land, repeating the same process of destruction until the whole countryside became denuded of trees.

When I first went into this country I pitched my tent on a hill known to the natives as Muguga, which means a treeless place. Here I looked out over a country which at one time had been all virgin forest, but was now bleak and bare. It was a fact that the rainfall had considerably decreased since the disappearance of the high forest, and this was beginning to reflect adversely upon the crops.

It was not a difficult task to convince the chiefs and elders, of the tribe of the importance of tree planting. Many *borazas*, or meetings of the chiefs, were held, and the importance of planting trees in the bare spaces was emphasised ; and these wise old men realised that something must be done to remedy the situation.

Too often their womenfolk had to go long distances to fetch, may be, a few sticks with which to cook their food, and they saw that the day was not far away when there would be a wood famine in their land. At the same time they said they were helpless in the matter and unable to undertake the organisation of tree planting

by themselves. It was to the Morans (or young fighting men) that they must look to carry out the work. These Morans lived their care-free lives, their time very much taken up in social engagements and in accumulating a sufficient number of goats with which to purchase their wives. They thought little and cared less of the consequences of a possible wood famine. For their part they did not have to carry the wood and it mattered little to them if their *bibis* (wives) had to go one hour or two days to fetch the sticks, so long as it did not interfere with their dancing. These young warriors seemed to think of little else than attending *n'gomas* (native dances). If the news spread that there was to be a dance, they would come from far and wide to attend ; so it was under the pretext of dancing that on an appointed day three thousand stalwarts of the tribe turned up at my camp.

It was a sight to be remembered. Long before the hour fixed, they started to arrive. On they came in companies, each headed by their captain—first the juniors and finally the older men—their bodies painted in picturesque or fantastic designs and each man carrying his spear and shield, as if prepared for battle. They fell in by ranks, in front of a platform which had been previously erected, and took their orders from their respective captains. When they had all assembled and silence had been called for, I addressed them as follows :—

"Men of the Kikuyu tribe, I have brought you together to-day because a reproach hangs over your tribe. Too long have you been known by the name of Forest Destroyers. In the past, whenever you have wanted to make a new *shamba* (cultivation) you have gone into the forest and cut down the trees. You have done this because it is there, in the forest, that you have found the best soil. Have you ever thought that it is the trees that make the good soil in which you can grow the best crops ? If then you are to go on finding good soil, you will have to plant up the old cultivations with trees, so that when all the virgin forests have gone you will be able to return to the young forests which you yourselves have planted. To-day I am going to call for volunteers, for men among you who will undertake to plant ten trees each year and take care of trees everywhere."

This day fifty volunteers came forward and a badge of membership was tied on their left wrist to remind them of their obligation. No more volunteers were called for, but after the initiation of the first fifty members each candidate had to be proposed by his chief, who had taken the rank of forest guide. Later on the scout ideal was added, to do at least one good deed each day, and a secret sign and password was instituted to safeguard the organisation.

At the initiation the attention of candidates was always drawn to the colours of the Men of the Trees. They are green and white ; green to remind members of their obligation to plant trees, and white because every member's heart must be *safi*, meaning clean. If any member had an unfulfilled obligation he could not be said to have a *safi* heart. At first the "good deed a day idea" was not readily understood by them, and often in the evening thirty or forty members would come to my camp and say, "Great White Chief, we have come to you to ask you to help us to think of a good deed. In two hours the sun will set, and so far we have been unable to think of a good deed." This little difficulty was overcome by starting a forest nursery close by, where members were allowed to plant out fifty young trees, which counted as their good deed. At the same time it was explained to them that this was not necessarily the best kind of good deed ; they must *search their hearts to find other things* to do.

Since these early days candidates have learned to understand the true meaning of the scout ideal, and often little deeds of kindness are done to assist, may be, a neighbour or an old woman. There have also been instances where members have come to the assistance of settlers and refused to accept rewards, as they are Forest Scouts. One day a settler was proceeding to Nairobi with a load of produce in his Ford, and as he approached a particularly muddy stretch of road "Tin Lizzie" came to a standstill and refused to be coaxed on her way. Forest Scouts come to the rescue and pushed the car on to firm ground. When the settler was ready to start off again, he offered *baksheesh* to the leader of the party who had come to his assistance. He was greatly surprised, however, when this boy spoke up for the rest and

said, "Please let us off taking *baksheesh*, as we are Forest Scouts, and what we have done will not count as a good deed if we take a tip. Please let us off and we shall be thankful."

Already they have proved themselves true to their promises in many ways, and to-day there are over three thousand members of the tribe wearing the same badge of membership, having taken the threefold promise, all belonging to the same brotherhood. Where one time tribes were suspicious of each other, to-day they exchange hospitality, for are they not all Forest Scouts? This movement started in so small a way, is rapidly spreading and bids fair to become a power for good among these primitive tribes.

Up till now the Forest Scout method of re-afforestation has only been applied in Kenya Colony, but those in authority are realising that such methods are capable of a very broad application and it may not be long before Forest Scout organisations are formed in other parts of Africa with variations adapted to local needs and conditions.—[*R. St. Barbe Baker* in *American Forests and Forest Life, June* 1924, *pp.* 330—333.]

FORESTS AND RAINFALL.

The question of the influence of woodland upon rainfall is a very old one, yet it cannot be said even now to be fully answered. While there is indisputable evidence from all parts of the globe that the reckless destruction of forest-growth has brought progressive desiccation in its train, it has only comparatively recently come to be realised that the problem is essentially hydrological rather than meteorological. When, indeed, one reflects that a *forest is itself primarily an adaptation to rainfall and other* climatic conditions, it is somewhat surprising that the earlier investigators should have expected to find anything more than a secondary reaction of the forest upon rainfall. No doubt the characteristic type of forest prevailing in moist regions like Europe helps by *maintaining the humidity of the atmosphere* to equalise, if not slightly to increase, the rainfall over the year as compared with denuded tracts; but, on the other hand, recent

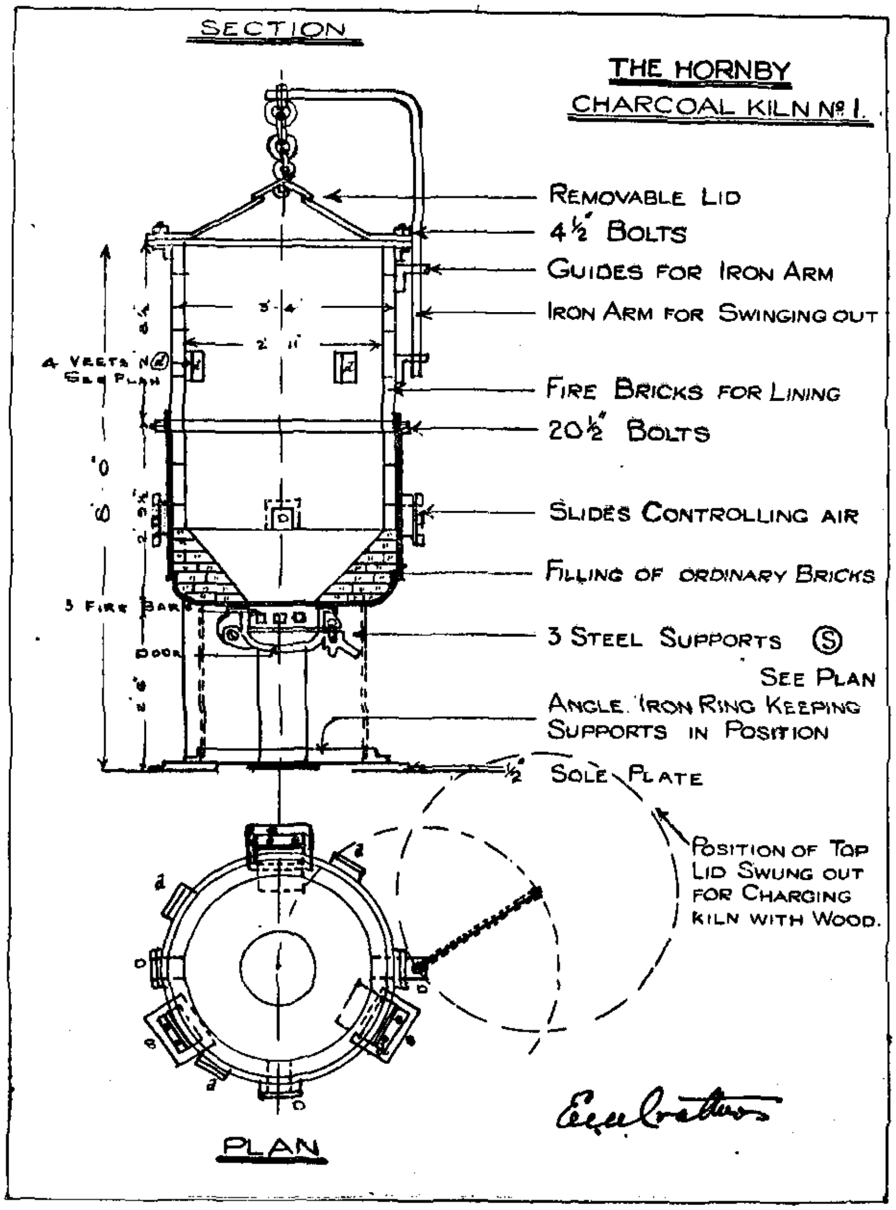
research by Quayle in Australia (Proc. Roy. Soc. Victoria, Vols. 33 and 34, 1921 and 1922) has shown that where forest and scrub are composed of drought resisting species, reducing transpiration to a minimum, a distinct increase of rainfall has followed deforestation in the interests of settlement and the replacement of xerophilous vegetation by grass and crops.

It is, however, as a hydrological agent that forest plays an immensely important part in conserving moisture in the soil regulating its discharge into rivers, and in generally modifying the natural drainage of a country, though the precise effect must vary with the nature of the country and the climate. It is satisfactory to find that this deeper understanding of what is in reality a very complex problem in physical geography is leading to investigations abroad, as in Italy where, according to Prof. Filippo Eredia, the various hydrological services are studying the relation between rainfall and woodlands in all its aspects ("Boschi e precipitazioni acquei," La Meteorologia pratica N. 1, 1922).

One very important fact bearing upon this subject remains to be pointed out. It was shown by that eminent climatologist, Julius von Hann, that there is a way in which forests do very decidedly increase "rainfall" in the broader sense of the term, namely, by collecting the moisture of fog. This is especially true of hill-fog and mountain mist. Upland fog is, by its different mode of origin, normally wetter than lowland fog, and on drifting across wooded mountain slopes deposits large quantities of moisture. Even in the drier lowland fogs produced by radiation on cold nights it is a familiar fact of observation that there is a constant dripping of water beneath trees, which, when the temperature is below freezing-point, become heavily decked with rime, often collecting on the ground like a light snowfall.

In this connexion, the experiments or Dr. Marloth on Table Mountain in the opening years of this century, and published in the South African Journal of Science and elsewhere, deserve to be more widely known. He showed that the vegetation of the

mountain, as well as rain-gauges fitted with wire-netting collected large quantities of water from the hill-mists produced in the moisture-laden S. E. Trade.—[*Nature, Vol. 113, No. 2840, p. 511.*]


SECTION
THE HORNBY
CHARCOAL KILN No I.
REMOVABLE LID
4½" BOLTS
GUIDES FOR IRON ARM
IRON ARM FOR SWINGING OUT
4 VENTS
SEE PLAN
FIRE BRICKS FOR LINING
20½" BOLTS
SLIDES CONTROLLING AIR
FILLING OF ORDINARY BRICKS
3 FIRE BARS
DOOR
3 STEEL SUPPORTS (S)
SEE PLAN
ANGLE IRON RING KEEPING
SUPPORTS IN POSITION
½" SOLE PLATE
POSITION OF TOP
LID SWUNG OUT
FOR CHARGING
KILN WITH WOOD.
PLAN

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THE WORKING OF THE HORNBY CHARCOAL KILN.

The following description and notes on the working of the Hornby Charcoal Kiln may be of interest to the readers of the *Indian Forester*. The Kiln is made of steel throughout ; it consists of a cylindrical portion (Kiln proper) in two sections, flanged to bolt together accurately ; the lower section is provided with 3 steel supports, which can be removed when moving the Kiln from one situation to another. The upper section is fitted with a lid, which can be swung out at will (see plan and section). At the bottom of the lower section of the Kiln there is a grate consisting of 3 fire-bars removable at will. Both sections of the Kiln are provided with vents, which can be opened and closed as required during the process of manufacturing charcoal.

Situation for a Kiln.—The Kiln should be situated in the most sheltered position available, the idea being that the air should be drawn in and not blown into the Kiln as the former is the easier to regulate. I have found it convenient to have a light bamboo screen placed on the windward side of the Kiln to protect it from a direct draught of air.

Erection.—After putting the kiln in position as indicated in the sectional drawing appended, the next step is to build the cone of ordinary brick and mortar in the lower section of the kiln, taking care not to cover any portion of the grate. Above this construction, the lining of fire-bricks is put in, care being taken not to brick up the vents. What is necessary is to form straight arches over these vents. The fire-brick lining is done as follows :—Mix the fire-clay with water in a bucket till it attains the consistency of cream. Dip the bricks in this mixture, turn

them about till well coated, withdraw, drain off drippings, and lay the bricks in position as in ordinary brick-work. It is very essential to have joints between bricks as fine as possible, as otherwise there is a danger of the fire getting through the plaster, at the joints and burning the steel sides of the Kiln. As soon as the brick work has set hard the Kiln is ready for work.

Charging the Kiln.—Swing off the top cover to one side, open the bottom door of the grate, and slide open the draught vents to the full extent. Then begin the filling by placing some combustible material on the fire bars to facilitate lighting the Kiln. I have found chips of wood sprinkled with a little kerosene oil serve this purpose very well.

Above this should be placed a layer of twigs to a depth of 2 to 3 feet; this layer also assists in facilitating the lighting of the Kiln and serves as a cushion for the heavier wood, which will be packed in over it. The instructions received with the Kiln lay down, that wood cut into 1 ft. lengths may be slung on in bundles, one across another, but I have found by experiment that packing the billets by hand in a vertical position, as is done in the case of the paraboloidal over-ground Kiln gives much the best results. The packing is continued in tiers till the Kiln is filled to the top. It is now ready to be lighted.

Firing.—Light the combustible material on the firebars at the bottom of the Kiln, then partially close the bottom door leaving it about one or two inches ajar. Leave all the vents as well as the top cover open fully, until the fire is well started, and is flaming fairly freely, which usually takes about 10 to 15 minutes. The bottom door can be left open till the flame shows itself at the bottom row of vents. Then close the bottom door, put on and bolt the top cover. Any additional air required subsequently to keep the fire going,—if damp or green—fuel is used, may be obtained by removing one or more bars from the grate.

Burning.—When through the lower vents the wood is seen to be glowing a dull red, these vents should be partially closed, and left in that condition till the fire shows at the row of vents above; then close the lower vents almost completely,—that is, leave them open to an extent of $\frac{1}{8}$ of an inch.

After about 3 hours from the time the Kiln was lighted, the bottom row of vents must be closed completely. When once closed they should not be opened again or the charcoal below these vents will be reduced to ashes. The burning should be continued till it is necessary to completely close the upper row of vents. This will be about 6 hours from the time when the Kiln was lighted. The instructions with the Kiln describe a process of adding fuel whilst the burning continues, which is termed "topping off," but I have found that in doing so the quality of the charcoal is somewhat inferior to that produced without adding fuel during the burning process.

Closing up the Kiln.—When the flame has reached above the top row of vents, the cover should be screwed down as tightly as possible. If any leakage of smoke occurs anywhere around the lid or at the vents, a little fire-clay, mixed with water to the consistency of cream, should be applied to stop the leakage. In this condition the Kiln should be left for the night.

Drawing off the charcoal.—The charcoal can be withdrawn by opening the door at the bottom and removing the firebars All other vents and the lid should be kept closed. If the Kiln has been kept properly sealed up, no glowing bits of charcoal will be found, but if any leakage has occurred a few pieces here and there may be found alight, which should be sprinkled with water as soon as detected. It will have been noticed that the management of the Kiln is very similar to that of the paraboloidal over-ground Kiln. The vents in this case can be closed rather more easily than in that of the paraboloidal over-ground Kiln.

Labour required for a Kiln.—Four men can fill the Kiln in $\frac{3}{4}$ of an hour. One man can manage the Kiln without assistance. The Kiln if lighted at 8 o'clock in the morning may be closed up by 6 o'clock that evening. The charcoal can be drawn off, and the next charge put into the Kiln immediately.

Size of billets.—For a Kiln of the size described in these notes, billets up to 6″ diameter may be used, the best size being 4″ in diameter and 12″ long.

Patching the fire-proof lining.—After a charge has been drawn off and before refilling the Kiln, it should be carefully examined for cracks. These need patching up before the Kiln is used again. Patching is done as follows:—Ordinary clay should be mixed with water to the consistency of treacle; with this mixture wash over the area to be patched; over this apply fire-clay mixed with water to the consistency of paste, using it like ordinary plaster in brick-work. The thickness of a patch must not exceed 2 inches. A thicker patch is liable to crack as it dries and to fall off.

Statistics.—Below is given the results of 14 charges of the Kiln. Soft wood and hard were mixed in most cases. Two charges of hardwood used pure are given (*Acacia Sundra*) for comparison with the results of mixed hard and soft woods. The lowest percentage by weight to the fuel used is 23 and highest 35.

With an over-ground paraboloidal Kiln as described in Prof. Troup's *Manual of Utilisation* the best results obtained with a species like *A. Sundra* were 20 per cent. The charcoal was weighed and measured immediately on being drawn from the Kiln in all cases. The cost of producing a ton of charcoal including the value of the fuel used amounts to Rs. 30, the cooly-wage in the locality being Re. 0-6-0 per day per man. The quality of the charcoal is very good, being much better than it is possible to produce in any form of temporary over-or under-ground Kiln. The Kiln described above was purchased from Messrs. Massey and Co., Engineers, Madras, F.O.R., Kurnool, for Rs. 950. With the Kiln, enough fire-bricks and fire-clay are supplied to keep the Kiln going for some time. These Kilns can be obtained in larger sizes than the one depicted in the drawing, but the question of portability comes in. A No. 1 size Kiln weighs a ton and can be carried by 2 carts quite easily, a larger Kiln may not be so easily portable. A section of it may weigh a ton, and no ordinary bullock cart could deal with such a load.

E. M. CROTHERS, I.F.S.,
District Forest Officer,
Kurnool West.

STATISTICS RELATING TO THE MANUFAC

Serial number of charge.	Date and hour of firing the Kiln.	Date and hour of closing the Kiln.	Date and hour of drawing the charcoal.	Kind of fuel used.	Age of fuel used.
1	2	3	4	5	6
1	3rd February 1922, 12 noon.	3rd February 1922, 7 P.M.	4th February 1922, 8 A.M.	$\frac{1}{3}$ Poliki ... $\frac{1}{3}$ Battaganupu. $\frac{1}{3}$ Billudu	11 months...
2	4th February 1922, 12 noon.	4th February 1922, 6 P.M.	5th February 1922, 8 A.M.	$\frac{1}{2}$ Billudu ... $\frac{1}{2}$ Battaganupu.	Do. ...
3	5th February 1922, 10 A.M.	5th February 1922, 6 P.M.	6th February 1922, 7 A.M.	$\frac{1}{3}$ *Poliki* ... $\frac{1}{3}$ Billudu. $\frac{1}{3}$ Korivi.	Do. ...
4	6th February 1922, 11 A.M.	6th February 1922, 7 P.M.	7th February 1922, 7 A.M.	$\frac{1}{3}$ Tandra ... $\frac{1}{3}$ Battaganupu. $\frac{1}{3}$ Musti.	Do. ...
5	7th February 1922, 11 A.M.	7th February 1922, 6 P.M.	8th February 1922, 7 A.M.	$\frac{1}{4}$ Tandra ... $\frac{1}{4}$ Chinta. $\frac{1}{4}$ Battaganupu. $\frac{1}{4}$ Tandra.	Do. ...
6	8th February 1922, 11 A.M.	8th February 1922, 6 P.M.	9th February 1922, 7 A.M.	$\frac{1}{3}$ Poliki ... $\frac{1}{3}$ Billudu. $\frac{1}{3}$ Tandra.	Do. ...
7	9th February 1922, 11 A.M.	9th February 1922, 6 P.M.	10th February 1922, 7 A.M.	Tandra ...	Do. ...
8	14th February 1922, 12 noon.	14th February 1922, 7 P.M.	15th February 1922, 7 P.M.	$\frac{1}{4}$ Tandra ... $\frac{1}{4}$ Velaga. $\frac{1}{4}$ *Sundra*. $\frac{1}{4}$ Billudu.	Do. ...

TURE OF CHARCOAL BY A HORNBY KILN.

Quantity of fuel charged in the Kiln.		Quantity of charcoal obtained.		Quantity of charcoal obtained in each Kiln.	Percentage of charcoal obtained in weight.	Botanical names of species mentioned in Col. 5.
By volume in c.ft.	By weight in lb.	By volume in c.ft.	By weight in lb.			
7	8	9	10	11	12	13
33	728	14	168	Good ...	23·c8	Poliki—*Givotia rottleriformis*, Griff. Battaganupu.—*Adina cordifolia*, Hook. Billudu—*Chloroxylon Swietenia*, D. C. Korivi—*Ixora parviflora*, Vahl. Tandra—*Terminalia belerica*, Roxb. Musti—*Strychnos Nux-vomica*, Linn. Velaga—*Feronia Elephantum*, Corr. Sundra—*Acacia Sundra*, D. C. Gumpani—*Odina Wodier*, Roxb. Chillareni—*Albizzia amara*, Boiv.
32	840	14	224	Fair ...	26·66	
34	616	14	171	Do. ...	27·76	
33	812	14	223	Do. ...	27·46	
33	840	13	231	Do. ...	27·50	
31	784	12	154	Good ...	19·64	
33	868	14	210	Fair ...	24·19	
32	784	12	231	Good ...	29·46	

STATISTICS RELATING TO THE MANUFAC-

Serial Number of charge.	Date and hour of firing the Kiln.	Date and hour of closing the Kiln.	Date and hour of drawing the charcoal.	Kind of fuel used.	Age of fuel used.
1	2	3	4	5	6
9	15th February 1922, 10 A.M.	15th February 1922, 6 P.M.	16th February 1922, 7 A.M.	¼ Velaga ... ¼ Tandra. ¼ Chikareni ¼ Billudu.	11 Months.
10	16th February 1922, 9 A.M.	16th February 1922, 7 P.M.	17th February 1922, 7 A.M.	¼ Velaga ... ¼ Tandra. ¼ Gumpani. ¼ Billudu	Do ...
11	17th February 1922, 10 A.M.	17th February 1922, 6 P.M.	18th February 1922, 7 A.M.	¼ Billudu ... ¼ Billudu. ¼ Korivi. ¼ Velaga.	Do. ..
12	18th February 1922, 9 A.M.	18th February 1922, 6 P.M.	19th February 1922, 7 A.M	⅓ Velaga ... ⅓ Billudu. ⅓ Tandra.	Do ...
13	1st March 1922, 8 A.M.	1st March 1922, 6 P.M.	2nd March 1922, 8 A.M.	Sundra ...	Do. ...
14	2nd March 1922, 9-45 A.M.	2nd March 1922 6 P.M.	3rd March 1922, 7 A.M	Do. ...	Do. ..

TURE OF CHARCOAL BY A HORNBY KILN.

Quantity of fuel charged in the Kiln.		Quantity of charcoal obtained.		Quantity of charcoal obtained in each Kiln.	Percentage of charcoal obtained in weight.	Botanical names of species mentioned in column 5.
By volume in c.ft.	By weight in lb.	By volume in c.ft.	By weight in lb.			
7	8	9	10	11	12	13
30	896	14	266	Good ...	29·69	Poliki—*Givotia rottleriformis*, Griff.
						Battaganupu—*Adina cordifolia*, Hook.
34	924	14	266	Do. ...	28·78	Billudu—*Chloroxylon Swietenia*, D. C.
						Korivi—*Ixora parviflora*, Vahl.
36	840	15	259	Do. ...	30·83	Tandra—*Terminalia belerica*, Roxb.
						Musti—*Strychnos Nux-Vomica*, Linn.
30	896	14	259	Do. ...	28·90	Velega—*Feronia Elephantum*, Corr.
						Sundra—*Acacia Sundra*, D. C.
37	1,120	23	401	Do. ...	35·62	Gumpani—*Odina Wodier*, Roxb.
30	1,036	21	350	Do ...	33·78	Chillareni—*Albizzia amara*, Boiv.

REGENERATION FELLINGS IN THEORY AND PRACTICE.

It is a commonplace that theory and practice may differ widely. In Forestry, and not least in its creative branch silviculture, this is particularly true. It is thus that each country tends gradually to develop its own technique for the regeneration of woods, and in the case of two European nations, close proximity, and no great difference of locality conditions, have not prevented extremes in silvicultural practice. France has long been the exponent of natural regeneration, Germany of artificial reproduction: the one has pinned her faith largely on the seed-tree, the other has relied mainly on dibble, hoe and spade. In Germany, indeed, rigidity in applying silvicultural systems has become proverbial. No other country has upheld their identity and distinctiveness so effectively and enthusiastically. Of these systems, those producing regular crops—and this excludes only the selection—are five in number :—

(I) SHELTERWOOD.—A large area is treated at one time and a series of cuttings or "successive regeneration fellings" is made so as gradually to admit light to the seedlings. The fellings comprise preparatory (where necessary), seeding, intermediate and final cuts, their number and severity depending on the rate of establishment and upon the early growth of the reproduction.

(II) SHELTERWOOD GROUP.—A modification of the above whereby valuable advance growth, if present, forms the nucleus of concentrically arranged cuttings. The groups thus eventually merge into each other and regeneration is completed.

(III) STRIP—(*a*) *Narrow Strip*.—Commencing from the leeward side, narrow strips in a stand are clear felled and seed is blown in from the adjoining trees. After regeneration is secured, an additional strip is felled, and so on.

(*b*) *Progressive Strip*.—Another modification of the shelterwood method. Successive regeneration fellings are made over narrow strips, at such intervals of time that reproduction is proceeding in three strips simultaneously, one being at the removal (final and intermediate) stage, one at the seeding and one at the preparatory.

(*c*) *Wagner's Progressive Strip.*—The stand is divided into a number of felling series of moderate depth, and cuttings proceed from N. to S. irrespective of wind, configuration, etc. The three zones of (*b*), though present, cannot be clearly distinguished, as they are cramped together on a strip some 50 yds. deep. There is thus a definite increase in the density of the crop—and therefore of shade—from N. to S. on the strip. Progress is very slow: on an average only 2—3 yds. are added annually to the depth of the step. Moreover final fellings are very conservative and are not made until some years after the regeneration is established. In this way the whole felling series is finally regenerated.

(IV) PHILLIP'S WEDGE.—This system was evolved by Eberhard but has not been adhered to by him. Phillip has modified it as follows:—

Compartments to be regenerated are divided into strips 90 yards broad by extraction lines. Regeneration is obtained by method (III) (*b*) but advance is on two fronts which form an acute angle or wedge. This wedge, bordered by the extraction lines, advances over the compartment strip; on slopes it must proceed downhill, on the level against the prevailing winds. The idea is to save the young regeneration from damage and ensure a minimum of extraction-labour, especially on steep gradients, al the trees being felled downhill towards the extraction-lines There is also good control over light-intensity and mixtures of species having very different requirements in this respect can readily be obtained.

The systems briefly outlined above have long been the mainstays of natural reproduction in all countries where forestry is worthy of the name. It is perhaps curious that Germany, on whose soil most of them originated, should have applied them with such precision as largely to discount the creative potentialities of Nature. She has thereby accentuated the defects inherent in any system whatever; planting and sowing have come to supplant natural regeneration, not to supplement it. In short the system has too often been, not a means to an end, but an end in itself. And with such a tradition, her recent change in policy is rendered all the more noteworthy and instructive.

Since the war Germany has suffered a revolution in silviculture no less radical than that *affecting her political constitution.* To foresters it may well seem more momentous. This revolution, like any other, had a definite focus and its effects are still spreading. Of the "classic" systems we have enumerated, practically none are now employed. Wagner's alone is in full and successful operation at Gaildorf (Wurttemberg) and nowhere else. Here indeed, theory and practice scarcely differ. The felling series are some 300 yards deep and the reproduction strip about 50 yards with an average annual addition of 2 yards. Regeneration advances rigidly southwards and with a rotation of 100 years uphill-extraction on north slopes presents no difficulty. The line of demarcation between the old growing stock and the reproduction-strip is clear and absolute and advance growth in the old stands is ruthlessly cut out when encountered. The silver-fir, Scots pine, spruce and beech of these woods regenerate well, the graded light intensity on the reproduction strip ensuring proper conditions for the establishment of each in turn—the silver-fir and beech followed by *spruce and Scots pine.*

The success of this system at Gaildorf, however, is misleading and only proves its suitability to special locality conditions which it was expressly designed to satisfy. By providing complete sun-protection for an easily desiccated soil, it preserves that sufficiency of moisture necessary for the seedlings: on the other hand regeneration, if sure, is slow, and since the number of felling-series cannot be indefinitely increased, parts of the growing stock suffer from neglect. Again, the *numerous felling-*series required is a serious drawback to its introduction elsewhere; only an exceptionally constituted growing stock could avoid the trouble and sacrifice entailed.

The other systems, it is affirmed, as means of natural regeneration have failed. Turned suddenly radical, the German Forester has acted up to his convictions with characteristic thoroughness. Thus the shelterwood system, once so prevalent in Prussia, can now only be seen in operation at Salmünster and where much artificial aid is given by burying seed in furrows and scattering evenly those which have fallen naturally. It was

a former boast that as much as 16 cwt. of acorns had been added to the natural stock over a hectare of ground.

Phillip's Wedge system is practised only by Phillip himself, who raises artificially on his "wedges" twice as many seedlings as normal extraction of the old trees would destroy. With his subordinates the system finds no favour, but rather excites ridicule.

The shelterwood-group system, until recently in vogue at Kelheim (Bavaria) has now been abandoned as unworkable. The progressive strip-method (III) (*b*) has been discarded for some time, while the narrow-strip system (III) (*a*) can barely be recognised in a few compartments in the communal forests of Heidelberg; in Bavaria and Saxony it has been degraded into clear-felling and planting.

This wholesale abandonment of well-known systems on the part of an experienced forest personnel is a striking phenomenon. German forestry has reached a phase which may well become historical. The movement apparently had its origin in Wurttemberg and Baden where natural regeneration of silver fir is prolific and possibly indicated the lines which the revolution has subsequently taken. And the greatly enhanced cost of sowing and planting since the war must certainly have precipitated matters.

However that may be, the general dissatisfaction has had a definite result. A new regime, curiously described as "system of organised chaos" has been evolved in the above States. Briefly, all regeneration provided by Nature is taken advantage of and fresh indications of it watched for. Group-fellings extend advance growth and successive regeneration fellings are made here and there and in between (up to the limit of the possibility). As reproduction becomes general, progressive-strip fellings, sometimes in wedge-fashion, are executed to complete it. In other words, the possibilities of the "classic" methods being fully understood, each and all are applied in the regeneration area, as the officer thinks fit, system only obtruding slightly to ensure complete restocking. The German silviculturist is now following Nature instead of superseding her.

It is only natural that such a reversal of long-established silvicultural policy should not find complete acceptance in a country where forestry is so intensively organised, and where partisan feeling is well-developed. But nothing is more striking to the visitor than the universal tendency towards natural regeneration and a more rational silviculture, seen in recent sudden revisions of working plans and the interesting compromises indicative of Teutonic caution and conservatism but also evidence of the reality of the change.

Such a compromise can be found in the State and Communal forests of Freudenstadt (Wurttemberg). Wagner's influence is still apparent here but the old regularity is gone. Progressive strip fellings are carried out simultaneously on two fronts—N. to S. for sun protection, E. to W. against prevailing winds—the whole forming a stepped series. But the significant feature is the extension of advance growth in the old growing stock by group fellings. Yet as much as 20% artificial aid is necessary.

In the Schönmünzach Range of the Black Forest, the "Perforated Saw" type of regeneration is on similar lines, but is more elastic, despite limitations imposed by a rough climate and by the problem of extraction of large logs on steep slopes. Here a light preparatory felling in the old growing stock establishes vigorous groups well in advance of the progressive strips. Regeneration commences in hollows or next storm firm stands, or from the top of leeward slopes, while on N. and S. aspects, as a compromise between climatic safeguards and extraction facility, it is conducted on two fronts—one downhill, the other against the prevailing wind.

As a last example from Wurttemberg, Eberhard in the forest of Langenbrand combines his "wedge" idea with shelterwood and group fellings. A light preparatory felling provides a ground work of silver-fir and a small percentage of spruce. Thereafter no definite system is prescribed. Eberhard attempts here and there to introduce a "wedge" but only the principle and not the shape can be applied. A proportion of Scots Pine and Oak is readily obtained and only 20% of artificial aid is employed,

mainly on "sour" soils inimical even to spruce. The exposing of the mineral soil by making shallow "dishes" ensures almost complete natural regeneration.

Instances from other States could be multiplied indefinitely. In Heidelberg, the communal forests are regenerated with equal elasticity, but the introduction of spruce and other species among the young hardwood crop compels some regularity and renders Heidelberg a special case. It is not in the Odenwald but rather in the Black Forest that the typical Baden method of regeneration is to be found.

The new régime here attains its fullest expression, the regeneration period extending to two-thirds of the rotation and allowing the silviculturist a maximum of freedom. The state forest of Herrenwiess, the adjacent Schifferschaft Stock Company's forest near Raumünzach and the communal forest of Gernsbach are all good examples. Containing the same species – silver fir, spruce, Scots pine, beech and some larch and oak—they all have fertile soil on which the chief species, silver-fir, regenerates prolifically. No seeding felling as such is made, as seedlings of silver fir and some spruce appear everywhere under the stimulus of thinnings in the old stands. At Gernsbach the removal of cankered larch is sufficient. Group fellings extend the advance growth and the foci spread and merge by seeding feelings over a larger or smaller area, exactly as Nature indicates. The possibility is thus extracted anywhere, regeneration being a matter of light control. In these forests the mixture is being sacrificed to get light-increment of the best trees: Eberhard, on the other hand, under the shorter regeneration period characteristic of Wurttemberg, ensures a good mixture. The Baden policy, which produces an almost pure crop of silver fir, cannot however be criticised without intimate local knowledge. The reserved trees put on enormous increment in their free position and are allowed to stand over regeneration until their presence is definitely prejudicial. The nominal rotation is 120 years and the regeneration period 60 years or more. The young trees in a stand do not however, give the appearance of an irregular crop for long. In a few years after the final cut, the more suppressed growth has

put on rapid height increment and with increasing age the canopy becomes quite regular. An even-aged crop is certainly not wanted in localities with such a rough climate.

In conclusion it must be said that, sound as the method is, too much should not be expected from the success attained so far in Germany. Not only is great silvicultural skill necessary, but the applicability of the system depends on—

(*i*) An excellent road system.

(*ii*) Skilled felling and extraction.

(*iii*) A receptive moist and fertile soil.

(*iv*) Suitable species.

(*v*) Properly conducted thinnings, so that the mature trees may develop good seed-bearing crowns.

These conditions are all fulfilled in the Black Forest: moreover the silver fir is peculiarly adapted to requirements for it recovers rapidly from both suppression and injury and has the power of putting on light-increment late in life.

The possibilities of the method are further limited by the difficulty of obtaining uniform mixtures and of perpetuating light-demanding species, unless heavy fellings in patches are made. Again, the increased branching of the reserved trees reduces their value considerably.

There is perhaps nothing startlingly new in the method to the Indian silviculturist, but to the German it is an advance and a great discovery, and his enthusiasm, reflected in current forest literature, is very genuine. Its application in France to oak and beech crops would be of interest; and perhaps it may not stop there.

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THE ECONOMIC IMPORTANCE AND CONTROL OF THE *SAL* HEART-WOOD BORER *(HOPLOCERAMBYX SPINICORNIS)*.

In all countries research in forest entomology manages to convey the impression that it produces little that is of direct use to the executive forest officer. The average entomological bul-

letin with its detailed life-cycle studies, its technical descriptions, its records of discarded theories and incidental experiments does not appeal to his taste. It is either rejected or is digested hastily, and the core of practical results remains undetected in the voluminous fruit of the investigation. What the forest officer requires, it has been said, are not life-histories but death-histories ; not suggested remedies but tested remedies. Hence, the question whether theoretical remedies for the control of forest pests should be tried out by the research officer or by the executive officer is bound to remain debatable. The Indian Forest Service is particularly well constituted for the experimental testing of control measures, yet its record in this field is not exemplary. The subject of this article is an account of almost the first case of practical control-operations on a large scale against an insect pest in the forests of India,—the control of *Hopoloceramhyx spinicornis*, the large heartwood borer of *sal* in Thano forests near Dehra Dun. It has taken nine years to introduce and carry through a fair trial of the remedial measures devised, and to achieve that important corollary—an estimate of the financial and silvicultural success of the operations. Foresters throughout the *sal* forests of India will be indebted to the forest department of the United Provinces for an effective demonstration of the practical control of their most important timber pest.

In 1916 an epidemic outbreak of the large *sal*-borer was discovered in the *sal* forests of Thano Working Circle, Dehra Dun Division, which stands on a *chaor* or terrace at the base of the Himalayas. The area affected extended over nearly eight square miles of country with 4,883 acres of forest. It is now known that the epidemic had been working up for several years to the degree of severity at which its existence was recognised, and that the predisposing factors were climatic, in particular rainfall above the normal. The beetles attacked the living trees in the rains, July to September, and their larvæ, boring in the sapwood during the remaining months of the year girdled the trees to death. Trees of all sizes and ages were attacked and the distribution of the attack was closely in direct proportion to the constitution of the growing-stock.

The epidemic ran on unchecked for four years and during that period the timber damaged by the borer amounted to nearly a million cubic feet, representing a loss of Rs. 2,68,562, at a depreciation of about 4 annas a cubic foot standing.

The figures below give the actual number of trees sold as insect-attacked, the total volumes, and the average loss per cubic toot in the year of sale.

Loss due to the Sal-Borer, Thano, 1917—1919.

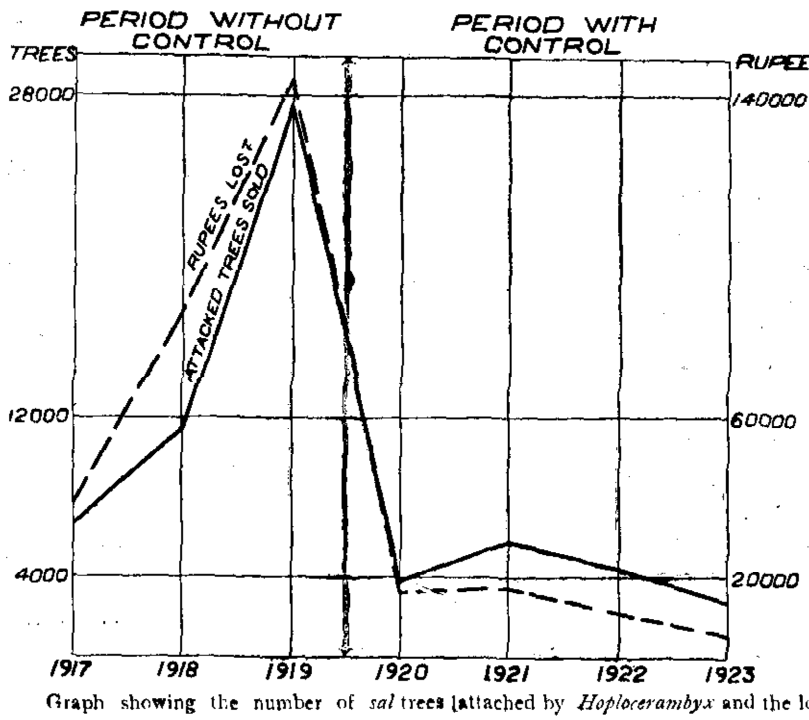
Year of sale.	No. of attacked trees.	Volume of attacked trees.	Average loss per cubic foot.		Total loss.
		Cu. ft.	a.	p.	Rs.
1917 ...	6,772	178,955	3	5	38,214
1918 ...	11,336	286,288	4	10	86,483
1919 ...	27,480	502,221	4	7	1,43,865
Total ...	45,588	967,464	...		2,68,562

A loss of over two and a half lakhs was incurred, and the epidemic ran on unchecked until the measures that had been suggested at the outset by the Forest Research Institute were eventually adopted in 1920. The remedy was applied in the season 1920-21 and its controlling action began to operate in the following season, so that from 1921 onwards a real decrease in the abundance of the beetle and the amount of the loss was effected. The figures below give the actual number of trees marked as insect-attacked, their total volumes, the average annual depreciation per cubic foot and the total loss incurred during the period of control work.

Loss due to the Sal-Borer, Thano, 1920—1923.

Year of sale		No. of attacked trees marked.	Volume of attacked trees	Average loss per cubic foot.	Total loss.
			C. ft	a p.	Rs.
1920	...	3,855	86,713	3 1	16,710
1921	...	5,825	83,692	3 4	17,436
1922	...	4,411	67,402	2 8	11,233
1923	...	2,625	42,981	2 7	6,939
Total	...	16,716	280 788	...	52,318

During the four years of the period under control measures the average annual loss was reduced from Rs. 89,521 per annum to Rs. 13,079 per annum, and to Rs. 6,939 in the fourth year. This represents an average reduction equivalent to 85 per cent. A graphical comparison of the losses in trees and rupees during the periods with control measures and without is given in the annexed diagram.



Graph showing the number of *sal* trees attached by *Hoplocerambyx* and the loss incurred each year.

The incidence of attack on the growing-stock has been reduced to less than one per cent. in the year 1923 and there is therefore no question that the epidemic has been successfuly fought and is all but stamped out. These results are assigned directly to the action of the remedial measures.

The average human patient, who has taken the medicines prescribed by his doctor and who has been cured of his ills, is content to assign his cure to medical aid. Yet there are some unbelievers who contend they would have got well anyway, if the doctor had *not* been called in. For the benefit of similar sceptics of entomological aid, it is necessary to demonstrate that the remedy has been instrumental in effecting the cure in Thano forest. To this end the normal unchecked course of the epidemic may be regarded in three phases :

(*a*) a steady increase in the numerical abundance of the borer at the same rate as that occurring from 1917—1919;

(*b*) a maintenance of the incidence at the level reached in 1919;

(*c*) a steady decrease in the numerial abundance of the borer *from the level reached in 1919 to that* reached in 1923.

All these phases are within the bounds of probability from natural causes, while a fourth case—the complete and immediate cessation of the epidemic—is improbable on the facts of the incidence in 1923.

In case (*a*) the loss during the latter period would have exceeded thirty lakhs of rupees by 1923 and the forest would have been seriously depleted.

In case (*b*) the total loss for the period would have been Rs. 3,66,200.

In case (*c*) the total loss for the period would have been Rs. 1,66,683.

Hence, under the most unfavourable conditions for control work, that is on the supposition that the outbreak has died out naturally, the amount saved is over one lakh of rupees (Rs. 1,66,683—52,318 = 1,14,365).

Evidence exists to show that in years of rainfall above the normal, the abundance of the borer increases.

The rainfall of the years 1921, 1922 and 1923 has been above the normal in Thano and these years have been favourable for the maintenance of a high and probably increasing incidence. Maps have been prepared showing the distribution of the attack and its intensity from year to year, and these maps clearly show an extension of the borer-infested territory from 1920 to 1922. The figures below illustrate the foregoing statements :—

Comparison of Borer-Territory and Rainfall, Thano.

Year	1920.	1921.	1922.	1923.
Area with infestation of 1 tree per 2 acres.	2,180	2,818	3,630	2,075
Area with infestation of 1 tree or more per 1 acre	1,334	1,652	1,350	734
Rainfall in inches	78·49	116·96	121·34	84·92

Hence it is concluded that the epidemic was on the increase from 1920 onwards, and the general incidence of attack in the previously lightly attacked areas was rising to the level of one tree per two acres, in spite of the fact that the remedial measures were reducing the total attack in the heaviest centres.

The loss prevented by the control operations is estimated at a sum between one and three lakhs of rupees. It is a net profit, as the operations were carried out by timber purchasers at no extra cost to the Local Government (beyond the usual enumeration costs) ; to this sum should also be added Rs. 12,780 the revenue realised by the sale of the attacked timber.

On a very much smaller scale similar operations against *Hoplocerambyx spinicornis* were carried out in Nagsidh forest of the same division. In 1921 from the attacked area 785 *sal* trees were removed ; on the timber of these trees a depreciation of Rs. 2,928 was incurred. By 1923 this area of infestation had been cleaned up and only two attacked trees were discovered.

Dehra Dun division is not the only locality in India where damage by *Hoplocerambyx* occurs on a large scale. The extent to which trees are killed and timber is affected is very imperfectly recognised and is rarely regarded as of sufficient importance to

require special action. As an off-hand estimate of the quantity of dry *sal* wood in his annual coupes the Divisional Forest Officer would probably incline to 5 per cent. Yet a careful scrutiny of the yields of any connected series of fellings, or of the figures for the total outturn of *sal* timber of a Province (in which dry and green timber is discriminated) would show that 20 to 30 per cent. is a more normal figure for the outturn of dry *sal*. Fourteen years ago 3,000,000 cubic feet or 47 per cent. of the total outturn of *sal* from Government forests was classed as dry. At the present time records of dry timber are maintained in only a few provinces and private forests. On actuals the *sal* forests of Buxa, Jalpaiguri and Kurseong vary between 30 and 38 per cent., those of Orissa 20 to 25 per cent., Mechpara Estate is placed at 49 per cent. In the United Provinces the proportion is *estimated* at 5 per cent. (which is less than the actuals of insect attacked trees for Thano alone).

Various causes bring about the death of *sal* trees but very, few of them preclude the attack by borers afterwards. The outturn of dry trees may therefore be taken in most localities as an index of the amount of damage by *Hoplocerambyx*. It is customary to assess recurrent annual damage by insects at 10 per cent. and this ratio though evidently low for *Hoplocerambyx* may be applied in the present argument.

The quantity of *sal* timber converted and in the round from all sources in India, that is damaged each year by the heartwood borer may be placed at over 1,100,000 cubic feet, of which 900,000 cubic feet is produced in Government forests. At a depreciation of 4 annas per cubic foot, the annual loss on *sal* timber extracted from Government forests amounts to Rs. 2,25,000. This loss is preventable; and the measures for its prevention exist in the prescriptions of Working-Plans that authorise dry wood or unregulated fellings. As now instituted such fellings, like other similar silvicultural operations, have no value as protective measures, because *(a)* the intervals at which they recur are too long, and *(b)* the felling or extraction of the selected trees does not take place until the season following the marking.

Protection can be assured by the adoption of the following principles:—

Sal forests that remain unworked for more than five years should be surveyed in the autumn and winter for dead and insect-attacked trees, which should be cut out and removed before the following rains. The felling should continue in the following and subsequent years in those areas where the infestation remains higher than one per cent. of the growing-stock (or alternatively one tree per acre). Except in unusually remote areas these fellings should pay for themselves. Below are given the rates offered for sound and bored timber standing in Thano forest with a lead of 4 to 8 miles to a railway station (including rates at which contractors have carried out the prescribed remedial measures).

Sale-price per cubic foot of sound and bored timber, Thano, 1917—1923.

Sale-price per cubic foot in year.	1917	1918	1919	1920	1921	1922	1923
	Normal felling and extraction.						
	a. p.	a. p.	a. p.	a. p.	a. p.	a. p.	a. p.
Sound timber	6 9	7 5	7 6	3 3	4 2	3 9	3 10
	Normal felling and extraction.			Special control fellings and extraction.			
	a. p.	a. p.	a. p.	a. p.	a. p.	a. p.	a. p.
Bored timber	3 4	2 7	2 11	0 2	0 10	1 1	1 3

The main object of subsidiary fellings of this nature is the reduction of the proportion of borer-damaged timber in the regular coupes and the consequent improvement in the reputation of the forest. At the moderate estimate of a 10 per cent. improvement the *sal* forests of the United Provinces (with an outturn of 4,500,000 c. ft.) might produce an increased revenue of Rs. 1,12,500 or nearly two annas per acre per annum. While the forests of Bengal and Bihar and Orissa might be expected on the present depreciation percentage to give an increased revenue of Rs. 70,350 and Rs. 73,250 per annum respectively.

It should be evident that it is worth while recording the proportion of dry wood in the annual coupes of all *sal* forests, and that in many divisions the institution of short cycle protective fellings would be profitable.

Forest Research Institute,
Dehra Dun.

C. F. C. BEESON,
Forest Entomologist.

THE MYSORE DISTILLATION & IRON WORKS, BHADRAVATI.

The Mysore Iron Works commenced work early last year and their output, at present, is about 300 tons of charcoal iron per week besides other valuable products of the destructive distillation of wood such as calcium acetate, wood naphtha and settled tar in commercial quantities. The works are situated at Bhadravati on the Bhadra river, about ten miles from its confluence with the Tunga river, and about 11 miles from Shimoga on the Birur-Shimoga branch of the Mysore Railways. All round the works in the Kadur and Shimoga districts, there is a fine stand of forest containing mostly *Terminalia*, *Cassia*, *Calophyllum* and *Dipterocarpus*. The present stand is expected, by the authorities, to yield wood for carbonization as well as fuel to the retorts for about 25 years. Meanwhile, the forest authorities are busy in the regeneration of some of the useful species for distillation purposes.

The present supply of iron ore is obtained from Chattanhalli about 30 miles beyond Shimoga, a haul to the plant of about 41 miles. This is only a temporary supply for the first two years of operation and the permanent supply is to come from a place in the Bababudan range, 25 miles south of the plant.

The raw materials are delivered to the plant over a system of 2 feet gauge tram lines built and worked by the Mysore Government.

The Works.—The four important sections of the works, as at present functioning, are the following; the carbonization plant where the fuel is destructively distilled in closed retorts and charcoal and pyroligneous acid recovered; the distillation plant or the chemical house where crude methyl alcohol, calcium acetate, tar and light oils are recovered from the crude pyroligneous acid;

the crushing plant where the ore and flux are crushed to a 2" ring before being charged into the blast furnace ; the blast furnace plant where using charcoal as the reducing agent and dolomite as the flux, high grade pig-iron is made. To make the whole undertaking a success each of these sections, though separate in themselves forms an organic and dependent part in the operation of the whole plant.

The other equipment which interests probably more an engineer than a forest officer consists of a boiler plant with a 200 H. P. boiler, three 350 K. V. A. alternating current generators, three water pumping stations with a circulating capacity of 2,300 gallons per minute, foundry, machine shop, etc.

Design.—The plant was designed by Messrs. Perin and Marshal, New York, and is one of the most modern and well-equipped plants, of its kind, in existence. Eighty-seven thousand tons ot hard-wood tar, per year, was the figure fixed for the capacity of the carbonization plant, thus fixing the capacity of the other plants.

Forest Officers are chiefly interested in the carbonization and byproducts recovery sections.

Wood Yard.—From the forest the billets are either loaded into charcoal buggies or stacked in the wood yard which can hold a year's supply of wood (stacked in cord wood piles 4' × 4' × 8').

Wood Distillation Plant.—The carbonization plant consists of a battery of 6 units, each unit consisting of two rectangular retorts made of steel plate with ½" bottoms and ⅜" tops. All the retorts are of the same size, being 54' long, 8' 4" high and 6' 3" wide and each holds four buggies with a capacity of 2½ cords per buggy. Each unit has its independent chimney and normally distillation in the two retorts of any unit goes on simultaneously. In general, 1½ tons of charcoal is obtained from each buggy of four tons of wood so that in a day 72 tons of charcoal is obtained.

Carbonization Process.—Each retort is charged with four rectangular buggies containing billets of wood varying from 6" to 12" in diameter and about 52" long by a light steam traction engine.

The retorts, being side by side, are equipped with duplicate doors at either end, with proper packing and swivel bolts ensuring

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air-tightness during the process of carbonization. Recording pyrometers are inserted in the neck of the condenser so that the temperature of gases leaving the retorts *during the carbonizing* period of 24 hours is recorded.

The exothermic point is reached usually in about 6 hours after charging. It is the practice to keep the temperature, if possible, below 650° F but if the wood is too dry, it often rises to 900° during the exothermic period, in which case it carbonizes too fast, and considerable portion of the byproducts are lost. Too rapid carbonization also makes brittle charcoal.

Coolers.—After the charge is completed the charcoal is transferred to the primary coolers in which it cools, out of contact with air, for 24 hours. The coolers are of the same size as the retorts but made of ¼" steel plate and provided with similar air-tight doors on either side. The charcoal is then transferred to the secondary coolers which are identical with the primary ones, but located in tandem with the retorts and the primary coolers. The charge is allowed to remain for 24 hours in the secondary coolers, and then, the transfer car pulls out the charcoal into the charcoal shed which is an open building 60 ft. wide × 250 ft. long. On the fifth day, the charcoal is sent to the blast furnace.

Condensers.—There are two outlets from each retort which convey the products of carbonization into two condensers which are ordinary vertical surface condensers made of copper through-o except the water jacket which is made of steel plate. The total capacity of each is 1.500 gallons in 24 hours. They have each 195 tubes 1½" diameter and 7 ft. long.

Auxiliary Tank and Pumphouse.—The pyroligneous acid liq r discharges into a funnel on a liquor-collecting main which, sp nning all the twelve retorts, leads the liquor to the collecting ta ks. The liquor is pumped from the collecting tanks to the cl..mical plant by a Dean ball-valve electric-driven (all-brass) pump. The non-condensible gases are returned and burnt in the retort furnaces.

Chemical House.—The pyroligneous acid is pumped from the wooden receiving tanks, in the retort house, into 12 wooden tanks, 12' diameter and 10' high of a total capacity of 90,000

gallons. The settled tar is drained off by gravity, into the collecting tanks.

From the storage tanks the acid is pumped into a wooden feed tank 8′ × 8′. From the feed tank, the acid liquor goes to the copper "triple-effect evaporators" in which the soluble tar is removed by the evaporation of all the acid liquor.

The condensate from the copper triples passes on to a surface condenser liquor pen, and thence passes on to a distillate cooler. From there, it is pumped to the oil separators where the clear liquid is drawn off to the neutralizing tank to which calcium hydroxide is added and the whole mixture agitated by a propeller with wooden blades.

The neutralized liquor is pumped, by a centrifugal pump, to the settling tanks where the excess lime and sludge separate out. The settled liquor is pumped to the feed tank for the continuous still located 70 ft. above the floor line. The continuous distillating apparatus consists of an iron still 7′ in diameter, made in 6 sections, of which, three are for condensing the alcohol vapour. The steam still is very similar to that used in benzene distillation. The methyl alcohol obtained per day amounts to about 500 gallons, and the authorities do not find any difficulty to dispose it of.

The calcium acetate, of which four to five tons is the average daily production, satisfies the British Standard Specification. The authorities obtain a purity of 80 to 85%.

Conclusion.—Among the by-products of the plant, the slag of the blast furnace is utilized for railway ballast, while those of the distillation plant, *i.e.*, acetate of lime and wood naphtha have a ready market. A sample of the third most important by-product of wood carbonization, namely, settled tar, amounting to about 7 to 8 tons per day, was sent to the Forest Research Institute for investigation as to its suitability for the antiseptic treatment of timber, and the preservation of railway sleeper woods in particular. No field tests, in India, are as yet available to give us an insight as to its value for the treatment of timber. Though there is a great difference of opinion as regards its toxic properties as determined by the laboratory culture tests, the greatest

impediments to its being used for the pressure treatment are due to the large amount of free carbon present and due to its high corrosive action on iron and steel, presumably, owing to its light low boiling oils and to the presence of bodies of the acetic, formic and butyric acid type.

Crude coal tar and wood tar were tried, during the last century, for the impregnation of timber but with little success. The authorities have realized the futility of trying to find a profitable market for the crude tar, and have decided to erect a tar distilling plant with a capacity of about 6½ lakhs of gallons per year. From the distillation, it is expected that about 80,000 gallons of wood preservation oil will be recovered annually. Though no field tests in India are available, of sleepers treated with wood creosote, it is accepted generally, that it is a very valuable antiseptic. It will be interesting to see Mysore, with her 400 miles and odd of permanent way, treating with this oil her 'jungle-wood' sleepers of which several fortunately appear to be amenable to pressure treatment.

The carbonization plant, besides being the only one in India, is probably the most up to date and the largest of its kind in Asia, and is well worth a visit by Forest Officers.

The author wishes to acknowledge his grateful thanks to the Mysore Government for allowing this article to be published in the *Indian Forester*, for giving him the permission to take the photographs shown in Plate 21 and for affording him all facilities in obtaining information about the plant, etc.

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SYLVICULTURAL NOTES FROM MADRAS.

THE RESULT OF CLEAR FELLING ON A SEEDLING CROP OF "HOPEA PARVIFLORA."

The experiment was conducted in May, 1924, over an area of 6·23 acres in the Parappa R. F., South Mangalore Division, Madras, under the direct supervision of the District Forest Officer and myself.

Fig. 1. Crude Liquor Settling Tanks. Chemical House.

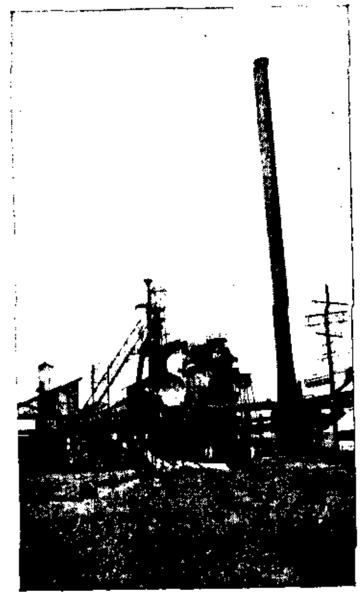

Fig. 4. Blast Furnace.

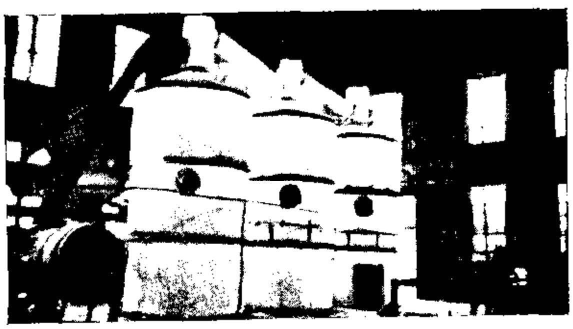

Fig. 2. Copper Triples.

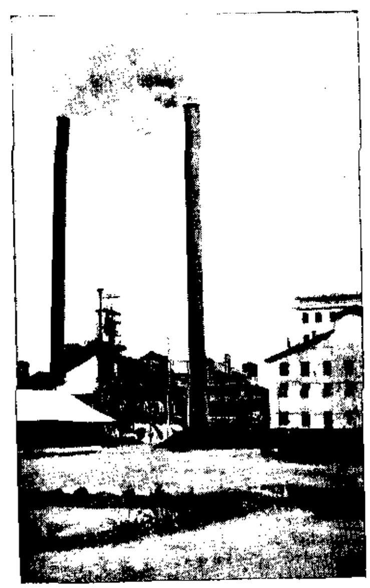

Fig. 5. General view of Blast Furnace and Chemical *House*.

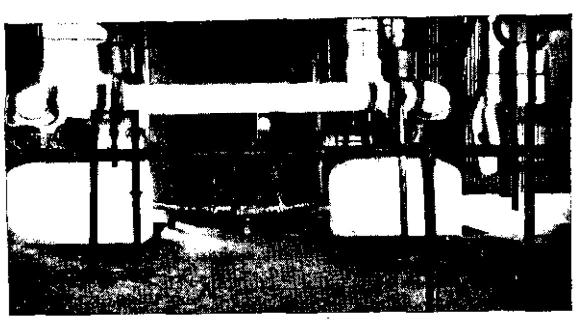

Fig 3. Alcohol Still and Boiler.

The seedling crop is the result of broadcast-sowing in 1910-11 and during the last four years experiments have been carried out on the area to discover the effect of different degrees of shade on the seedlings of this species ; the crop therefore is not now uniform in height or density.

An enumeration of the seedlings before felling gave the following figures :—

0′ – 2′	2′ – 4′	4′ – 6′	Over 6′	TOTAL.
381	1,152	2,271	3,175	6,979

A stock-mapping of the area showed blanks, as regards *Hopea* seedlings, to the approximate extent of 1·25 acres ; the figures quoted in this note may therefore be taken to apply to an area of five acres.

The operations of felling and clearing were spread over five days and an elephant was requisitioned to remove the larger logs.

The importance of felling all trees as nearly as possible with their butts towards the road was impressed upon the subordinates but the lie of the land and the shape of the trees in many instances made this end unattainable. In addition to this I was not struck with the skill of the axemen in directing the fall even of the comparatively straight stems. Apparently the system of directing the fall with ropes, or of removing the bigger branches before felling is not practised in this district, and moreover, I was assured by the local subordinates that none of the coolies could climb !

I did find one man who volunteered to climb, but it took him over 20 minutes to climb a very moderate sized tree and break off a fairly small branch, and he looked so unhappy about it that I abandoned the idea.

Looking back at the experiment, I do not think that the prior removal of branches would lessen the casualties among the seedlings to any appreciable extent, while the operation would undoubtedly tend to decrease the value of the timber by increasing the liability to shake.

I was agreeably surprised by the little damage done. Comparatively speaking, very few casualties were incurred in the actual felling, the majority being caused by the elephant while removing the larger stems. On the drag-paths used by the elephant a number of seedlings were badly damaged without being broken, though far fewer than I had expected to see, and I had most of them cut back, but a certain number I purposely retained in order to observe their powers of recovery. I selected one patch of about 100 sq. ft. and cut back all the seedlings in it and fenced it in. The progress of these stumps will be noted. I also selected 30 seedlings varying from 2′—9′ in height: these will be re-measured annually for the purpose of determining the average height increment of the plot.

The resiliency of *Hopea* seedlings is most remarkable, and had it not been for this characteristic the number of casualties must have been far larger. During the extraction I watched one seedling about 8′ high, knocked down and completely passed over by three successive logs, and on examination it was found little the worse for its treatment.

The final enumeration of the area gave the following figures :—

0′ – 2′	2′ – 4′	4′ – 6′	Over 6′	TOTAL.
477	1,061	1,975	3,068	6,581

In the course of this enumeration the following damaged seedlings were cut back :—

0′ – 2′	2′ – 4′	4′ – 6′	Over 6′	TOTAL.
31	69	124	127	351

The increase in seedlings in the 0′—2′ class must be attributed to the greater ease in enumerating after felling and extraction.

To summarise on an area of five acres containting some 6,600 established *Hopea* seedlings roughly equivalent to an average stocking of 6′ × 6′, (the 0′—2′ class is omitted as not being necessarily established) the casualties occasioned by felling and

extraction averaged only 100 per acre, or $7\frac{1}{2}$ per cent. ; and it is to be expected that a number of those casualties will re-establish themselves in the course of a few years. The work was more carefully supervised than would be practicably or economically possible over a large area, and all species are not so elastic as *Hopea*, but the experiment can fairly be stated to have shown that the removal of the overwood from an area densely stocked with seedlings up to 9 or 10 feet in height may be undertaken with every prospect of success.

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URDU TEXT-BOOKS OF FOREST UTILIZATION AND SILVICULTURE.

REVIEW : (1) MASARIF-I-JANGLAT *or the vernacular translation of Mr. Troup's "Indian Forest Utilization"*; (2) TARBIAT-I-JANGLAT *or the vernacular translation of Mr. Jackson's "Manual of Silviculture,"* by MAULVI ABU YUSUF AHMAD MOHI-UD-DIN FARUKI, *Assistant Nazim of Forests, Hyderabad. (Deccan)*, without date and price.

The books are literal translations of Mr. Troup's "Indian Forest Utilization" and of Mr. Jackson's "Manual of Silviculture." They are the first of their kind in the Urdu language. They have been written for the use of the Local Forest School, Hyderabad, and Urdu-knowing Indians. All the illustrations given in the original books have been printed in the translations. The translator has produced a very useful work and it will be of great interest to Urdu-knowing forest subordinates, contractors and traders, and we have no doubt that it will fulfil the object of the translator. At the end of the books an index has been given to show the various local vernacular names of the trees and shrubs mentioned with their corresponding scientific names.

The translator has fulfilled a want in supplying Persian or Arabic synonyms for technical English words although some of them might be thought defective. In some cases, he gives very unwieldy Persian or Arabic words which are not in every-day use and it would be better if simple Urdu words were substituted for them. For instance, he gives *mulkhasat* for extracts, *imkanah* for buildings, *muadin* for mines, *cholinah* for timber, *habub* for seeds, *muquaomat* for resistance, *hezami sokhtni* for firewood, *lakri ki purnian* for wood vessels, etc, etc. The simple Urdu words *sat*, *makanat*, *kanen*, *imarti lakri*, *bij*, *muqablah*, *jalane ki lakri*, *lakri ki ragen*, etc., etc., would perhaps be better. We are given *sahra* for forest, *pate* for stems, *are se lakrian katnan* for sawing of scantlings, and these are not correct. The better and correct words are *jangal* for forest, *tannah* for stems and *karion ke chiran* for sawing of scantlings. Further in some cases it would have

been much better had he not given the Persian or Arabic synonyms for those technical English terms which are already commonly used in Urdu in preference to his Persian or Arabic synonyms, for say the following terms:—Standards, Working Plan, compartment, coupe, high forest, coppice, possibility, selection method, uniform method, clear felling, group method, improvement felling, cutting back, normal forest, etc., etc.

In our opinion in the next edition these and other English terms should be reintroduced, and simple and common Urdu words should be preferred to high sounding Persian and Arabic words.

It is hoped that the translations will fulfil the objects with which they have been published; and the Urdu-knowing people should be grateful to the translator for his placing within the reach of Urdu-knowing employees the knowledge of the practice of Forestry.

GURDIT SINGH.

THE EFFECT OF FIRES IN THE PINE FORESTS OF CALIFORNIA.

REVIEW: THE RÔLE OF FIRE IN THE PINE FORESTS OF CALIFORNIA, by SHOW, S. B., and KOTOK, E. I.,

U. S. Department of Agriculture Bulletin, 1924.

The Department of Agriculture of the United States has just issued a Bulletin from the Forest Service by S. B. Show and E. I. Kotok, entitled "The Rôle of Fire in the Pine Forests of California." In this very interesting treatise the authors trace the influence that fires have exerted in the mixed pine stands of California from the earliest known history as noted and recorded in the trees themselves, up to the present day. It is shown that the present stocking of old growth stands is largely the result of past fires, which have so culled the forest that the yields from the old ragged forest as now left to man are much below those which can be expected from the second-growth stands when fully stocked. Fires in the old growth virgin forest have affected the

destruction of the largest and most valuable individual trees largely through the enlargement of basal firescars. These basal-scars, gradually enlarged by repeated and often very light ground-fires in the litter, so weaken the tree that later on it is broken off by the wind or through a reduction in strength brought about by the entrance of fungi or the loss of wood volume.

In the California pine forests, there are no crown-fires as are known in other forests and other regions. Most of the fires are comparatively light, running along the surface of the ground and consuming only the forest litter and lighter fuels. The effect of these fires in the past has been overlooked for the most part as they lacked the spectacular features associated with the more destructive crown fires. They, far more than has been supposed, are responsible for the uneven-aged and broken stands so common in the Sierras, for the process of attrition is a slow one and not often recognised.

Not only is there a reduction in the quantity of wood produced in these forests, and a reduction in the number of trees through a continuous loss of young growth, but there is also a loss of site quality due to the reduction in the humic content of the soil. This is further reflected in the growth, for the killing of a portion of the cambium, the reduction in amount of leaf volume, and the other injuries to the tree direct and indirect, all combine to reduce the rate of growth of the individual. In addition, inferior species are encouraged.

It is pointed out that systematic fire protection is positive in its action rather than negative and has for its object not merely the prevention of loss, but the building up of the forest and of the quality of the land. It is not merely an added cost of production nor is it a part of what has been termed "over-head cost;" it is a part of the capital investment.

Fire should be recognised, not merely as an enemy of the timber-crop now standing, but as the ruthless foe to the very existence of the forest, a foe whose destructive work is always cumulative, for the final effect of the fire is to reduce the forest to brushfields or to scrub.

The uses of fire, such as burning for grazing and similar purposes, are incombatable with timber growing. With rising timber values, grazing will undoubtedly become secondary to silviculture on all forest land. In the California pine region, trees are a more profitable crop than forage, and it has not yet been proved that fire is the friend of the grazier as he has been in the habit of considering it.

Because of the similarity of conditions in California to those of the forests of India where the chir pine predominates this bulletin should be of great interest to those foresters especially working in the Indian pine forests.

E. N. M.

CREEPING FIRES.

REVIEW: THE DAMAGE CAUSED BY CREEPING FIRES IN THE FOREST, by S. L. KESSELL, CONSERVATOR OF FORESTS.

Bulletin No. 33 of the Western Australia Government, 1924.

In European practice, it goes without saying that if a forest is under systematic management, *it is fire-protected*, and the reasons for this are often considered so obvious as to require no explanation. In countries where scientific forestry is of more recent introduction, it may be seen over and over again, that attempts are made with varying success to initiate this policy, but that sooner or later, there follows a reaction. It is asked whether the results are commensurate with the energy and money expended, and the answer is commonly found in a compromise in the form of the recommendation of some kind or other of "*light* burning." It is not difficult to find arguments which the layman can understand in support of this idea; in fact if the layman is personally affected, and is anxious to get the forest burnt somehow or other, he will back up these arguments to a degree liable to be embarassing to the trained forest officer, who is more than likely to feel that he is being urged against his instincts in the matter. Most often, the forest officer, having seen the results of

his own and his predecessors' efforts at protection, continued over many years, go up in smoke, becomes an unwilling convert, he admits that though, light burning is not good for the forest, it does less harm than a periodic holocaust at the height of the worst seasons after a period of successful protection.

India has encountered this problem to a severe degree, and after a long period during which universal fire-protection was almost a fetish, a strong reaction has occurred which some may think is tending to go too far, but which probably all admit is justified under certain conditions. It is, therefore, specially interesting to us in India, to read the experience of other countries in this matter, and we have before us an instructive pamphlet dealing with the conclusions reached in the coniferous forests of the Pacific slopes of the Rockies, from the pen of an experienced officer of the Western Australian Forest Service, Mr. S. L. Kessell.

The bulletin under review is mainly a reprint of an article published in the July 1923 number of the Portland *Timberman*. The foreword justifies the application of U. S. experience to the eucalypt forests of Western Australia, in terms which might be transferred almost verbatim to many parts of India, with a change only of the names of the trees.

It must be remembered that the Pacific slope forests are purely coniferous, and so would be expected to be comparable with the coniferous forests of the Himalaya, but just as the deductions made from observations in the former are applicable, in Mr. Kessell's opinion, to the W. Australian gum forests, with the chief difference that fire-damage is often less obvious in broadleaved crops even when equally existent, so also it is likely to be useful to see how far they may be applicable to the numerous types of forest we have in India.

In dealing with forest problems in the U. S. A., technical foresters there have the advantage of getting a second point of view which is unlikely to be biassed in the same direction as their own on any matter, we refer to the opinion of the big timber owners who speak from practical experience with little danger of unconscious reproduction of views derived from the text-books,

It is, therefore, of interest to note that a special Committee of the U. S. Forest Service, the University of California, and two of the biggest timber owning bodies in the West, after three years' consideration, discard light burning as unquestionably injurious, and unequivocably advocate absolute fire-protection as both preferable and practicable.

No less than fourteen points (the number evidently has special significance in the U. S. A.!) are marshalled as having been put forward in support of light burning, as compared with a mere six against it, and so 14 fallacies have to be exposed if an adverse verdict is to be given. In view of the importance of the problem in India, and to the difficulties now being experienced in the Himalayan forests through uniformed political support of the practice of so-called light burning, to meet the demands of village populations, that believe in all of the 14 fallacies which they think affect them adversely, it is worth while to reproduce these points *in extenso*, though we have not space to discuss them all in turn :—

THE CASE FOR LIGHT-BURNING.

"1. That before the advent of absolute fire-protection, fires caused no great damage to timber because fires ran over the forests at intervals and prevented the accumulation of much inflammable débris.

2. That light-burning is practicable in all pine forests, and will prevent damaging fires.

3. That as a result of the practice of fire-prevention, great amounts of litter have accumulated, which result occasionally in very damaging fires.

4. That the fire-prevention policy was introduced from Europe, and that since there the inflammable material is removed by hand, the fire-prevention policy is not applicable to this country.

5. That the damage to mature timber by the practice of light-burning is negligible.

6. That fires do not fire-scar living trees.

7. That the clear trunks of much of our virgin timber is due to the occurrence of fires.

8. That fires kill the destructive bark beetles in the standing trees and that, therefore, fires control epidemic infestations and prevent their recurrence.

9. That the smoking and charring of the bark of living trees by fire prevents the entrance of insects into such trees.

10. That fire is a cleansing agent and fills the same function in the forest that disposal of refuse does in the cities.

11. That reproduction is undesirable in the virgin forest, because it hinders the group of mature trees.

12. That fire has a beneficial, selective action in dense stands of reproduction by thinning out the weaklings, and bringing the stand to the desired density without entirely obliterating it.

13. That brush fields within the timber-belt are not the result of fire, but are natural phenomena.

14. That light-burning prevents serious fires and that disastrous and uncontrolable fires will result from the accumulation of litter brought on by complete fire-protection.

THE CASE AGAINST LIGHT-BURNING.

1. The losses to merchantable timber by light-burning are considerable; by burning down of previously fire-scarred trees or fire-scarring uninjured trees to the extent that they are subsequently blown down by wind and storm; by actually killing trees due to heat of the fire; by cull and reduction in the grade of lumber due to fire scars and more rapid action of wood-destroying fungi; by greatly increasing the activity of tree-killing beetles; and by the reduction of growth of thrifty merchantable trees.

2. The damage to reproduction by repeated light fires is sufficient to make impossible the permanent production of timber.

3. Light-burning results often in the enlargement of brush-fields and the crowding-out of the forest where it once grew satisfactorily.

4. The grazing resources of areas which are lightly burned are gradually reduced in value because of the practice.

5. The difficulties of actually carrying out light-burning operations are tremendous and cannot be overcome at a cost many times in excess of the cost of systematic fire-protection.

6. The use of even regulated fires in the forests results in an attitude towards fire-protection on the part of the public which is hurtful to forest protection in general. It develops the feeling that special precautions to prevent fires are not needed since fires often do not result in much damage to merchantable timber any way. Even the most enthusiastic supporters of light-burning are anxious that those who use the forests exercise all possible care to prevent and suppress fires."

One detailed study revealed that with the lightest fire possible in *Pinus ponderosa* forest, 2 per cent. of the trees were killed off at once and a much larger number in the course of the next four years, and similar deductions follow from other observations. The Committee decided that..."*No burning yet critically studied failed to cause damage to mature timber, which was considerably larger than would be apparent to the casual observer.*" That the gradual felling of large trees through basal scars catching fire annually involves such unexpectedly high loss has been shewn by Mr. A. E. Osmaston for *Pinus longifolia* (cf. *Indian Forester*, 1914, pp. 387—391).

It may be admitted at once that in the Himalaya, the "bug" problem is not so serious as in the Far West, but it is of interest to note that in some parts of America it has been clearly proved that light burning is followed by an increase of several hundred per cent. in the pine-beetle damage.

As regards the effects on reproduction, which have also been made the subject of many investigations in the U. S. A. (notably by Show), Mr. Kessell's summarising remark, agrees, as far as it goes, exactly with the present writer's view and is..."The fact that light fires do not uniformly thin out the reproduction on the burns, but entirely wipe it out in considerable parts of them, is perhaps the most important point to remember in connection with the effect of light burning on reproduction." The often

extremely adverse effect on the quality of the trees originating from such injured reproduction is also not overlooked in this bulletin.

The question of the effect of light burning on the grazing resources of forest is unfortunately not further discussed—a careful investigation of this matter is one of the urgent requirements of forestry in the Himalaya—but that it is deleterious is accepted as proven. As regards undergrowth; the bulletin under review does not clearly distinguish between light burning and severe fires, but brings out the facts that *firing generally may* encourage brush, and may indeed result in the complete replacement of forest growth by brushwood almost devoid of timber. That whether a forest is subject to firing or not, may decide the relative proportion of the various tree species comprising it, is also recognised (cf. *Indian Forester*, 1923, pp. 116—135, for a *discussion of thisas affecting forests in the C. Himalaya*). Whether the more or the less valuable timber species will be favoured, will be largely a matter of chance.

Two points worth special note remain to be dealt with. One is of great importance in a country which is thickly populated by people who, with or without good reason, are strongly prejudiced against fire-protection, and that is the great difficulty attending an attempt to practice both methods in any given district or type of forest, as has been proposed, and tried for that matter, in some parts of the Himalaya. The population has to be an exceptionally highly educated one if it is to realise that fire is the worst of all possible evils on one side of a valley, say, and permissible on the other side, in a forest all of one tree species; it is asking too much to expect differentiation between the several stages of regeneration and subsequent development.

The second matter is one of finance. It has been realised in the U. S. A., as doubtless wherever else it has been tried, that light or "controlled" burning is a far simpler matter on paper than in the forest, and again, even when it is quite feasable to carry out successfully any given method of burning on a moderate scale, it is a very different problem to treat large areas in similar fashion. It is very difficult to decide just when to burn, and the

suitable time, in any case, may be of very short duration. What is simple in one year, may be almost impossible the next under different weather conditions; the cost incurred may easily be greatly enhanced, and even then, the forests may be in part insufficiently burnt to afford that subsequent reduced risk claimed as a special advantage of the procedure, and in part burnt by a fire by no means either light or controlled. These aspects of the problem apply with greater force to forests in hilly areas. Another difficulty is to decide what expenditure is justified, since if one favour light burning whilst admitting that it does damage, one can spend almost any sum in preliminary operations to reduce, such damage—a case is quoted of a large scale experiment in this direction costing some Rs. 3 per acre, with which may be compared the average figure of 9 annas per acre successfully protected for the submontane *sal* forests (95% success is attained) and 8 annas per acre similarly for pine forests in Kumaon. This problem so difficult of solution, of the justification of preliminary expenditure on clearing round the base of trees and so on in an area to be lightly burnt, becomes of first importance in our pine forests which are under resin-tapping, and is, it is believed, being experimented on in both the Punjab and the U. P. Mr. Kessell summarises his observations in the U. S. A. in the following words:—"*Aside from the damage which is done to merchantable timber and reproduction by all these varieties of light burning, the actual carrying out of the burning is full of practical difficulties, and the cost is excessively high in comparison with the results secured.*"

This applies primarily to the coniferous forests of the Rockies, is believed to hold for the gum forests of W. Australia, and is equally, true of the pine forests of the Himalaya.

The special firing of regeneration areas in both broad-leaved (*e.g., sal*) and coniferous forests after seeding fellings, is a separate problem introducing very different factors, and on the whole simpler to study, whilst the burning of evergreen forests under totally different climatic conditions, has also to be dealt with independently though some of the 14 *pros* and the 6 *cons* still apply.

C.

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HAY COLLECTION IN MALNAD STATE FORESTS, MYSORE STATE.

Owing to the scarcity of fodder in the Maidan Districts of the State, the Government of Mysore directed that the state forests of the Malnad and Maidan Districts of the State be thrown open to grazing as a first step to relieving the distress. The Maidan jungles could not supply the necessary fodder for the local cattle and it was therefore resolved by Government that the Agricultural Department should get together the Maidan cattle into small herds and march them to the Malnad forests to tide over the situation.

The length of the proposed march was about 150 miles on an average. It was arranged that at chosen centres at convenient distances, on the way, baled fodder be stored for supply in temporary depots. The Forest Department was, meanwhile to go on collecting and baling fodder grass in the forests, loose hay being stacked in ricks in the jungle for consumption by the incoming cattle and baled stuff for shipment to the camps on the route.

The original estimate of the required collection was between 4,000—6,000 tons of loose hay of which 500 tons had to be sent out baled to the several camps for the use of the marching herds.

The Forest Department started hay collection early in December 1923 but it was not till the first week of January 1924 that the work of collection was in full swing. Baling commenced from the middle of the same month, just about the time the writer of the report was placed on this special duty.

Owing to the large quantity of grass required in a short time, collection and carting was started in twelve forest ranges, employing in all 900 coolies per working day on an average. The collection and stacking at the site of collection was therefore complete by the middle of February 1924, and the tonnage reached was 2,000 tons for the two forest divisions of Bhadravati and Shimoga.

The shipping of baled fodder was steadily going on from the 15th of January 1924, from the three railway stations, Shimoga, Masarahalli, and Tarikere, on the Mysore State Railway. The bales were being booked to cattle camps stations on the M. & S. M. Railway within the State limits originally fixed by the Agricultural Department. The quantity of baled hay booked to cattle camps came to 480 tons by the 2nd March 1924, nearly completing the programme in this particular. Baling operations were, therefore, suspended in nearly all the centres—there were 5 such—from the end of the first week of March 1924, until Government issued revised instructions to bale all the loose hay on hand. The reason for this revision of the first programme was the failure to fight the prejudice of the Maidan ryots to bring out their cattle from their poorly wooded tracts to the dense jungles of the Malnad, which in their wild imagination was the land of lurking tigers and panthers ready to devour their cattle and of fantastic grim shapes ready to care for them as the wild animals would their cattle.

By this time the demand for baled hay had increased largely owing to the wide publicity given to the resolutions of Government and the increasing belief of the ryot population in the steadiness and certainty of supplies. Consequently a steam press was set up by the Agricultural Department to turn out bales faster to keep pace with the demand. For two months, during April and May, baling with the hand and steam presses was pushed through vigorously in spite of forced interruption of work by heavy showers now and again.

When baling activities came to a close in the first week of June 1924, 320 tons of hay were baled out with the steam

press, 830 tons with the hand-presses of the Irani, Leslie, and Ladder type, eight of which were in working order throughout the season. Loose hay remaining over in the jungle at the site of collection was 850 tons. These figures include 25 per cent. driage and 5 per cent. wastage allowed at the final stage, in consideration of abnormal conditions of working.

The cost of steam-pressing worked out to Rs. 14 per ton and hand-pressing Rs. 6 per ton, inclusive of the cost of baling wire. The cost of collection was, on an average, Rs. 11 per ton and of transport to railheads with an average lead of 8 miles was Rs. 4. The cost of a ton of steam and hand-pressed bales, delivered on the rail was respectively Rs. 29 and Rs. 21 per ton. Freight charges were entirely borne by Government. Steam-pressed hay at destination cost Government nearly the same or even less than hand-pressed hay per ton, owing to saving in freight on steam-pressed bales as can be seen from what follows. An ordinary C. G. N. Wagon of the M. & S. M. Railway holds 65 steam-pressed bales of 80 lbs. each against 27 hand-pressed bales each of nearly the same average weight, and the volumes of the two different kinds of bales,—hand-pressed bales being 9½ c.ft. and steam-pressed bales 4¼ c.ft. weight for weight—account for this packing. The freight for C. G. N. Wagon to the farthest and nearest destination stations was respectively Rs. 32 and Rs. 16.

In addition to the fodder grass, paddy straw from the channel area was also supplied to the affected localities. At first, fodder grass was very much disliked by the ryots as well as the cattle, but by and by the sale of the same increased owing to its comparative cheapness. Paddy straw sold at Rs. 1-6-0 and jungle grass at Rs. 1-2-0 per bale of 80 lbs.

Field work.—Collection and stacking was everywhere started departmentally as no contractors would come forward to undertake the work. Gradually some contractors were secured, but they all complained of heavy loss on account of driage, and backed out of their agreements.

The Range Officers were responsible for recruiting necessary labour. The gangs of coolies numbering from 30 to 40, which

consisted of 75 per cent. females and boys, were taken out by a Forester or a literate guard to the jungle and worked from 8 A.M. to 5 P.M. with a short interval at about 2 P.M. Grass on being cut, was made into bundles of uniform size which the Forester was required to weigh by means of a pocket spring balance to ensure that they were over 20 lbs. each. 7 to 9 such bundles were prepared by each coolie. When the working was systematised, collection was being done on piece work, each coolie earning as. 8 per day, having to give 8 bundles of grass of between 22 and 25 lbs. each which actually weighed only 19 or 20 lbs. by the time they reached the presses. Until proper arrangements were made for producing bundles of uniform size, trouble was felt at every stage of the work as can be seen from what follows. Cost of collection at the above rate of working reached a minimum of Rs. 8 per ton.

Carting.—45 such bundles of 20 lbs. to 22 lbs. wt. were loaded in a cart thus ensuring a full load for a cart in fairly open jungle tracks. Owing to the lateness of the season of collection, damage by fire and mixed patches of grass and undergrowth, really concentrated collection was not possible. This scattered cutting rendered cutting over long distances necessary in order to facilitate concentrated baling in chosen centres. Cost of carting came to Rs. 3 per ton taking an average lead of 4 miles along jungle tracks.

Baling.—Four of the jungle bundles were packed into a press—slightly more in the case of Irani presses. This measure ensured the uniformity of the weight of bales. It can thus be seen that the standardising of the jungle bundles rendered work in the succeeding stages more uniform, requiring less skilled supervision. Ties used were 16 guage copper wire cut to 8′ 10″ lengths. Four ties were necessary for one bale. To economise copper wire thin galvanised wire obtained from the Iron Works Stores at Bhadravati, were used in 3 strands for the 2 middle ties, the end ones being of copper wire for strength.

Rope ties were never resorted to, but when they were used to replace snapped wire ties at loading stations, they were found unsatisfactory. Bamboo slips and split cane would have been good substitutes but there was no time to secure them or to

train the coolies to use them either. The cost was Rs. 4 per ton for baling, not less than 3 presses being set up in one place Where any one or two of the presses got out of order, the cost of outturn rose as the same number of coolies could not be fully employed for working 2 presses and a smaller number could not be engaged without loss of efficiency.

Carting Bales.—Carting bales was a great difficulty as it never paid the cartman as well as timber carting. Hence the timber cartmen were indirectly forced to it by being allowed one trip with timber for every trip with bales. By practice, the cartmen loaded their carts better in the later stages getting 10—12 bales, instead of 8 or 9 as in the first trips. Much trouble was felt on account of the prejudice of the local coolies and cartman to go heart and soul into any new work other than the routine types of labour. It cost as. 2½ per bale on an average for transhipping one bale of 80—85 lbs. over 8 miles of metalled road. Loading into wagons at railheads was paid for at as. 12 to Re. 1 per truck according to the capacity of the wagon. In practice, it was found harder to load steam-pressed bales. In the case of hand-pressed ones indifferent packing did not matter, as there was always spare space at the top of waggon which could not in any way be filled up. Taken all together, it was undoubtedly cheaper to ship steam-pressed bales, though the cost of outturn was much higher; and, even that cost could be reduced by handling a larger quantity of loose hay than was actually possible in the course of a month and a half or two, with intermittent working, and out of season.

In the affected localities, the bales for sale were stored in depôts either under the control of the revenue authorities, usually the Amildars (Tashildars) or the Agricultural Inspectors of the several places The bales were nearly always stacked in the open, but were fenced in to keep out stray cattle.

The money allotted by Government for the distress operations was Rs. 90,000. Taking only round figures the cost of collection and pressing together with incidental charges, was Rs. 32,000 and freight at concession rates, of part of the total collection only amounted to Rs. 18,000 reaching a total of

Rs. 50,000 besides the pay and allowances of the staff employed exclusively on this duty both from the Forest and the Agriculture Departments.

Comparing results with similar operations in the C. P. for the supply of hay to the Army in Mesopotamia during the years of war, on a much larger scale, it is easily noticed that the costs of collection and baling are higher in Mysore, as ought to be the case with limited working and to suit a changing programme. The lowest rate per ton of pressed hay in the C. P. is as low as Rs. 12 in North Chanda Division, and the highest rate is Rs. 25 per ton in Jabbalpur-Narsingapur Division, while everywhere in Mysore the rate could not be kept below Rs. 21. The reason for this big difference is to be found in the cheapness of labour in the C. P. generally on the one hand and on the other the lateness of the season of commencing fodder operations in Mysore, in addition to the incidental increase in cost of production when attempting to meet a big demand at short notice out of season. Damage by fire and cattle was not very great. As there was no work during nights, there was the less danger of fire from Kitson lights and torches, which would have to be in evidence for working in the dark.

Drying and cleaning of grass on cutting seems to be necessary and conducted on an elaborate scale in the C. P. In Mysore generally the winter temperature is not so low nor is the dew fall so heavy. Hence the system of drying on end or spread out in single layers left for a week under shade does not seem to be necessary. Elaborate combs for cleaning grass from dry leaves and undergrowth and needles in some varieties of grasses as those employed in the C. P., were not used, nor thought necessary with varieties of grass worked in Mysore, and on a limited scale.

In Bombay Presidency, the chief feature of the operation is the storage zinc-sheet sheds constructed at great cost, *e.g.*, West Kandesh. To provide against years of fodder scarcity, the Bombay Forest Department store baled fodder every year to the extent of 100—150 tons anually and clear out the accumulated stock of 600 tons every four years by auction sale, if the same be

not drawn upon for relief of distress during the period. In order to keep the bales fresh for 4 years the longest, complete protection from sun and rain is necessary. Hence zinc-sheet roofed sheds open on all sides with drains running round the raised flooring are built at great cost. One such was built at a cost of Rs. 7,000 in West Kandesh some two years ago as far the writer could gather.

A type of temporary storage shed that the writer saw in Poona Cantonment consisted of two grass tatties placed resting against each other at the top and on the ground at the bottom 50′ apart. The tatties were 50′ × 50′ and were partly supported by the steam-pressed bales which were built up in *prism* form inside and they lasted only one season. The particular stack visited contained about 40 tons of steam-pressed bales.

The rate of supply of paddy straw at Anantapur, one of the badly affected British Districts is Rs. 1-5-0 per bundle of 80 lbs. The hay was got from the Krishna District and distributed by the local revenue authorities. Paddy straw was transported in ordinary unpressed bundles so that freight charges per ton were enormous, which were nevertheless entirely borne by Government.

It is indicated from the above that the cost of outturn of baled fodder may greatly be reduced by :—

(1) Beginning cutting and collection early in November and completing the same before January ;

(2) Carting cut fodder for baling in one centre ;

(3) By running a battery of hand-presses in the same place ;

(4) By carrying on cutting, collection and baling operations for 3 or 4 months annually and storing them for years of drought.

Many other minor details of working, *e.g.* selection of site for pressing, method of storing bales, etc., to further economise labour, cannot be gone into in a paper of this nature, but every attention must be paid to them to avoid inconvenience in the later stages of working.

D. NARASIMHA MOORTY RAO.
Special Duty, Hay Collection,
Bhadravati.

HOT AIR

OR TIMBER SEASONING IN VARIOUS COUNTRIES.

Happy is the Seasoning man who is "located" in the United States of America. There he is not considered as a nuisance or fanatic, but as an asset, because by the practise of his art he converts so much lumber into hard cash, 18—12 or 6 months earlier than under *laissez faire* conditions.

He has of course to show that the interest and amortisation, on the installation outlay, and working costs are less than the saving on capital and that the material is not depreciated, but once this is proven, the necessary apparatus is provided and the output of the sawmill goes through the drying process and comes out ready for immediate sale.

I have never been in that delightful position, on the contrary, for 18 years I have been battling with English, French, Italian, Dutch, Austrian and Finnish peoples, to persuade them to ignore their climates, and speed up the turnover. The English merchant with a few exceptions, either sells American kilndried stock, or can afford to hold big stocks and wait. The French or Italian argues long and technically and either does nothing, or puts down a small plant with a lot of complications. The hard-headed Scandinavian aims to just dry the wood enough to reduce shipping weight and make the material saleable.

On the technical side, the timber expert made up his mind that artificial seasoning was " against nature" and that the timber was spoilt. As people were experimenting with little hot stoves, rather than pay for acquired experience, and spoiling wood, there where plenty of examples to back up this opinion.

In various countries varying arguments turned the balance. In France a pending penalty on a Balkan war contract influenced Schneiders to install rapid seasoning apparatus for gun-carriage timbers, and to their astonishment, they not only got the timber seasoned in time, but found that there were less rejections on the artificially seasoned timber than with air-seasoned (when they could get it). Austrian Jews found that a Dryer turned forests into money quickly, as in three weeks a standing tree was felled,

sawn, dried, planed, and shipped as finished parquet floor blocks. The North Europe saw mills were losing four or five months of the year. They could steam melt the river and get out the logs and they could rail the sawn timber to an ice free port, but they could not dry the boards by one per cent. with 50 to 60 degrees of frost, and they had a selling specification saying "guaranteed NOT kiln dried." However a properly proportioned apparatus was evolved, which removed 30 per cent. of the wet weight (reducing freight and liability to damage in transit) and by avoiding high humidity the outturn was 'bright' and no one with objection to artificial seasoning would ever dream of its having been through the hated process.

In England, the war brought on a crisis in aeroplane timber supplies, and when all air-seasoned stock was at an end Willy Weir put his foot down, against the advice of many a timber expert (Mr. A. L. Howard and Prof. Percy Groom were about the only two in favour)—and as a result some twenty million feet of timber were dried by rapid methods, with most unhappy results—to the Bosch.

Artificial seasoning is not a complicated process, but you cannot treat everything the same way. The species of timber has to be considered, and also the climate of the country. A process that has proved excellent for pine in Finland may be quite unsuccessful for hardwood in Italy, and Dryers evolved to meet American and English conditions, have to be considerably modified before they will meet Indian conditions and climate.

It is one thing to deal with the output of a saw mill in Finland or America, which is daily turning out 40 or 50 standards of soft wood, all in one or two thicknesses, and quite another to accommodate the mixed scantlings that make the output of a railway carriage works.

In India, there are such a multitude of presentable timbers—some that season easily and without cracking, others can be used unseasoned without penalty, but a large number are very refractory and deteriorate unless guarded from the effect of a hot dry atmosphere—that considerable research is necessary before the

best treatment can be best prescribed and the latter put in a usable form for the commercial user.

It is the possession of such amenable timber as Teak, Rosewood, Deodar, Sal (which last stays wet), etc., that has enabled India to jog along without worrying about seasoning processes, but increased demand and shorter supplies have caused the prices of these few species to go up, and so other timbers are being considered now by important users.

These newly exploited timbers are presentable in appearance. or structurally strong, according to their class, but they many of them decline to part with their moisture in the amenable way that Teak and Rosewood behave, but season slowly or split badly. Some others would be useful if they were not so depreciated by fungus during slow seasoning.

In order to bring these into use, artificial seasoning is being tried and is showing excellent results. Some of the worst splitters come out of the Dryer without noticeable degrade, and in two or three weeks' time only, instead of taking 18 months or more. Incipient fungus wilts under the well ventilated high temperature conditions. This saving in time means interest on capital. Elimination or reduction of degrade for fungus stain means better quality and better price. But the most valuable use of rapid seasoning is that fresh timbers can be quickly brought into common use, and introduced to commercial users in a properly seasoned and attractive state, and without fear of subsequent troubles.

Artificial seasoning should rather be called 'accelerated' seasoning, it is not unnatural but follows the lines of open air seasoning under ideal conditions. Hot Air is used to extract and carry away the moisture, but its temperature is graduated from atmospheric temperature at the start, up to temperature of direct sun heat when nearing dryness. It is retarded by control of the humidity so as not to dry the exterior in advance of the interior, which would cause uneven contraction and splits; this can be compared to rains humidity. In other words you start with July (warm and humid) carry on with October (medium

temperature and humidity) and finish up with May (hot and dry) eliminating night cooling, and maintaining a steady ventilating wind all the time.

Different species require different variations of these conditions, that is some can go faster than others, but the experiments made up to the present on the lesser used Indian timbers, show that these can be seasoned in a very short time, and at reasonable cost, and without appreciable deterioration.

STANLEY FITZGERALD.

SOME NOTES AND PROBLEMS OF THE CENTRAL PROVINCES TEAK AREAS.

At the present time in the C. P. practically all the working plans are either old or old-fashioned. By old-fashioned I mean that they were written at a time when the writers were under the gloom that shadowed C. P. forestry; at a time when the writers had no hope that money would be available for any work except that of a revenue-getting nature. Hence they did not prescribe any silvicultural work except possibly Cutting Back Operations, which meant that second and third class species were cut back when they were likely to suppress the coppice from a teak stool, or when they were suppressing seedlings of the more valuable species. I expect that in most cases when these were prescribed it was only a faint, wild, and pious hope on the part of the writer.

But we now seem to be at the dawn of a better day for C. P. forestry. The powers-that-be are very keen on all works of improvement such as freeing teak seedlings, and especially thinnings, which are so urgently needed in the better class teak areas, that it is difficult to know where to start. What is more than mere keenness, we seem to be able to get at least some money for this work. Yet it is rather difficult to work at present owing to the fact, that an officer, when carrying out any operation, does not know what he is working for except that he is trying to increase the number of first class species in the forest. Therefore new working plans must be drawn up to suit the new and more hygenic fashions.

At the Conservators' Conference in 1922 a long list was drawn up of divisions in which working plan work should be started—a list that by no means included all the plans that were desirable, but only those which were very urgently required. In spite of this I believe that the only plans which have been completed are those of North Mandla and South Raipur. A few efforts have been made in other divisions, but these have since been given up owing to the reasons which follow.

At the present time the forest officers of the C. P. are either pre-war officers who are urgently required as Divisional Forest Officers for the more important charges, or they are post-war officers. It would appear, therefore that the whole thing is a matter of Hobson's choice and that the post-war officers would be put on to do the working plan work ; but this is not the case, for the powers who are above the mere professional forest officer, while seeming to have confidence in the post-war officer as far as forestry is concerned, consider that he is not competent to cater for the local requirements of the people. As however under the rules in the C. P. Forest Manual a Revenue Officer is supposed to be attached to the Working Plan Officer for this purpose, it is rather difficult to see what the real reason is ; perhaps it is a question finding a competent revenue officer.

This then is the first great thing which is keeping back C. P. forestry. It would be impertinence on my part were I to enumerate the many things which make a working plan essential, as these have been manifest to most forest officers since lack of forestry caused denudation and the Flood.

The second problem that has to be met in the C. P. was realised by Napoleon when he classed distance (=area) as the greatest military obstacle. I once heard it said that the C. P. forest officer used his 'area' as a shield with which to hide poor or unscientific work. I would mention that one of the best C. P. divisions has been calculated to be equal in size to sixty German Forest Divisions (the simile is not quite fair, but there is a little difference between the German staff and ours). I do not know the area of the average coupe in a Felling Series but am acquainted

with one coupe of 4,000 acres in area. This will illustrate the fact that the C. P. 'area' is not a shield but a reason.

It is quite impossible to get much done with the whole area of reserved forest in the C. P., nor would it be an economical proposition as a big proportion of the area in many divisions is very poor, either owing to the grazing difficulty or owing to the extreme poverty of the factors of the locality, or both.

At the present time there seems to be a rooted objection against having either a Working Circle or a Felling Series in the form of anything but a solid block. Owing to the way in which the type of forest varies from place to place, as long as this prejudice continues, so long will the lot of the Working Plan Officer be unhappy. The better class areas of not less than 300—400 acres, which contain a good proportion of teak, could be picked out and put into a single Working Circle, and unless there is more than one market no Felling Series are required, it is immaterial as to how many coupes are allotted for working each year, provided that they are sufficiently far apart to provide labour and grazing difficulties. Thus all the best class of area in each division would be separated out, and it would be possible to concentrate effort on this area. The remaining area would have to be worked much as it has been worked, or better still not worked until the predicted timber famine arrives, or a brighter day dawns which will make its scientific working possible. Thus in a sense the area difficulty will be reduced.

At the present this in nearly all the old plans for all types of area, either the Coppice with Standards System or the Improvement Fellings System is prescribed.

The name Coppice with Standards appears to be a misnomer, as I have known 60 standards per acre prescribed, this I think gives a standard about every twelve yards, and if these average about middle aged it would be more like high forest than Coppice with Standards. It is quite a nice system to mark under, as one can in practice mark as many trees as one wishes, and get rid of the many poles which are saleable as poles and not as trees (*i.e.*, *Dhaura*). However in the hands of the lesser trained of the

subordinates it is rather a poor system, as they think that they must adhere to the prescribed number of standards and so either reserve rubbish or fail to reserve some of the better class trees which should be reserved. The system at its best is of a slightly improving nature, at its worst it is not a silvicultural system.

Under the Improvement Felling System all the better class trees which are likely to improve during the course of the next Felling Cycle are kept in the crop, the others are marked for felling. Hence in actual practice the two systems come to much the same thing, except under one the trees that are for felling are marked, and under the other system the trees for reservation are marked, hardly a matter of silviculture. The Improvement Fellings System has the disadvantage that it is impossible to get rid of saleable inferior poles without copious marking.

Both systems require really good Cutting Back Operations if they are to be of any use. But in the past usually the money allotted, for even good areas, was a mere drop in the ocean. Under these circumstances the systems became thinnings among the teak to favour the inferior species. Both systems are fairly satisfactory when well backed up by good silvicultural operations.

Neither system is good enough for the better class teak areas, as it is difficult to reconcile the idea of using any uneven-aged system when the most important species are light demanders; this surely is one of the cardinal points of scientific forestry. Further it seems that the more light, air, and sun teak seed gets the more likely is regeneration to take place; this may be the reason for the terrible lack of regeneration by seed in some forests under these systems; in such cases the systems fail to do more than keep the percentage of the superior species at a constant.

It would appear, therefore, that the next great problem is to find a satisfactory even-aged system for the better type C. P. teak forest. There seem to be three possibilities: the taungya, clear-coppice, and a form of the Uniform Compartment System.

In most areas it is very doubtful whether the taungya system would be of use as the soil is usually poor, and the ground often rocky and hilly.

In some divisions the clear coppice system is being tried, and I rather fail to see the objection to it, provided it is backed by the cutting back of all species which the contractor does not remove. In the case of teak in areas where there is little danger from frost, the necesssity for mother trees is not marked, as the seed and seedling seem to do best in the open, and when a crop is removed the ground must be full of ungerminated seed, and even if the seedlings of one year are all killed there will be plenty of seed still about to germinate, for the seed will not all germinate in one year. There remains the Uniform System, and this is likely to be more palatable than the foregoing system, and may very likely be the solution of the problem, yet I doubt if it is superior to clear coppice.

It will be interesting to see when a start will be made with an even-aged system, if at all. At various schools of forestry one spends time trying to devise schemes to bring about some change in the forest for the least loss in revenue. If the even-aged system comes in it will be of interest to see whether the Working Plan Officer will make a plunge for the even-aged system or whether he will prescribe a modification of the two old systems to bring the forest into a more even-aged state, so that the even-aged system may be brought in at the end of the felling-cycle for which the plan is drawn up. I am doubtful whether this latter course would save as much as would appear at first sight, it is true that many undermature trees would be felled if the even-aged system should be brought in at once, but, on the other hand, when once the coupe was regenerated there would be a great increase in increment, as under an uneven-aged system nearly every tree of a light demanding species suffers from partial suppression during a large portion of its life.

It is very hard if the Working Plan Officer is asked to prescribe a system under the present conditions, as he cannot be expected to be certain as to whether one of the even-aged systems is likely to suit the division for which he is expected to prescribe. His work would be lightened if experimental plots were taken up in average good class teak areas in each division, which is likely to require a new Working Plan within the next fifteen

years. In these plots experiments could be carried out with the silvicultural systems for even-aged forest, which may appear to offer hopes of success in the locality for which the working plan is to be made.

In conclusion I wish to make it clear that the foregoing remarks cannot 'crab' the work of the forest officers of the past, as one has only to see the results to realise what wonderful work was done by them in spite of the hopelessly uphill game they had to play, and the difficult conditions owing to lack of staff and money. Lastly, I would express a faint hope that the old saying about grand-mothers and eggs will not be applied to me.

P.

NEW INDIAN SPECIES OF FOREST IMPORTANCE.
PART 6.

[*Continued from* Indian Forester, *Vol. XLVIII* (1922), *pp.* 247—258].

The present list includes 197 species and, as 550 species have already been enumerated in the previous lists, the total comes up to 747 species.

A list of 14 species omitted by oversight from the Index Kewensis has been given separately.

Many names which are invalid under the International Rules have recently appeared in Indian Floras, particularly in Mr. Gamble's Flora of Madras. It has been considered preferable to show these separately rather than to omit them altogether.

1. **Abutilon molle,** Sweet, *Malvaceæ* (Parker's For Fl., Punjab (1918), p. 39), Nat. in Lahore and Saharanpore—Peru.

Acacia dealbata, Link, *Leguminosæ* (Troup's Sylv. Ind. Trees, Vol. II (1921), p. 464), Nat. in Nilgiris and Palni Hills, New South Wales, Victoria, etc.

Acacia hydaspica, J. R. Drummond, Mss. ex Parker, *Leguminosæ* (Kew Bull., 1921, p. 309), N.-W. India Peshawar to Jhelum, Salt Range.

Acacia pseudo-eburnea, *J. R. Drummond ex Dunn* *Leguminosæ*, (l. c., 1922, p. 185), N.-W. India, Kumaon.

5. **Acer Wardii,** W. W. Smith, *Sapindaceæ* (Notes, Roy. Bot. Gard., Edin., Vol. X (1917), p. 8), Upper Burma.

Aeschynanthus sikkimensis, Stapf, *Gesneraceæ* (Curtis, Bot. Mag. (1922), t. 8938), Sikkim, Bootan, Khasi Hills.

Agapetes Wardii, W. W. Smith, *Vacciniaceæ* (Notes, Roy. Bot. Gard., Edin., Vol. VIII (1915), p. 330), Upper Burma.

Agrostistachys Meeboldii, Pax & Hoffm. *Euphorbiaceæ* (Das Pflanzenreich, Heft 57 (1912), p. 100), Ind. or (Malabar, Travancore).

Allamanda Cathartica, L., *Apocyanaceæ* Gamble's *Mad. Fl.* (1923), p. 821), *Nat.* in Travancore, *S.* America.

10. **Alseodaphne Owdeni,** Parker, *Lauraceæ* (Ind. For., 1924, p. 365), Cachar Hills, Assam.

Andrographis Lawsoni, Gamble, *Acanthaceæ* (Kew Bull., 1923, p. 375), S. India.

Anisochilus argenteus, Gamble, *Labiatæ* (l. c., 1924, p. 265), *S. India.*

Antidesma gymnogyne, Pax. et Hoffm. *Euphorbiaceæ*, (Das Pflanzenreich, Heft 81 (1922), p. 135), Tenasserim.

A. rotatum, Muell. Arg., *Euphorbiaceæ* (l. c., p. 117) Burma.

15. **A. Walkeri,** Pax. et Hoffm. *Euphorbiaceæ* (l. c., p. 118). Ceylon.

Aporosa frutescens, Blume, *Euphorbiaceæ* (l. c., p. 91), Burma.

A. Duthieana, King Mss., *Euphorbiaceæ* (Das Pflanzenreich, Heft 81 (1922), p. 99), Burma, Mergui.

A. ficifolia, Baill. *Euphorbiaceæ* (l. c., p. 94), Tenasserim, Tavoy.

A. obovata, Pax et Hoffm. *Euphorbiaceæ* (l. c., p. 100), Mergui.

20. **Asclepias physocarpa**, Schlect. *Asclepiadaceæ* (Gamble's Mad Fl. (1923), p. 833), Nat. in the Nilgiris. South Africa.

Astragalus aegacanthoides, Parker, *Leguminosace* (Ind. For., 1923, p. 78), Kumaon.

Bauhinia rufescens, Lamk., *Leguminosæ* (Gamble's Mad. Fl. (1919), p 409), Naturalised near Madras. Trop. Africa.

Berberis favosa, W. W. Smith, *Berberideæ* (Notes, Roy. Bot. Gard. Edin., Vol. XI (1919), p. 200), Upper Burma.

B. Lamberti, Parker, *Berberideæ* (Kew Bull., 1921, p. 307), N.-W. Himalaya, Almora.

25. **Buddleia Cooperi**, W. W. Smith, *Loganiaceæ* (Notes, Roy. Bot. Gard., Edin., Vol. X. (1917), p. 14), Bhutan.

Capparis auricans, Craib, *Capparidaceæ* (Kew Bull., 1922, p. 169) Burma.

Carissa salicina, Lamk. *Apocynaceæ* (Encycl. 1, p. 554), S. India.

Cassiope myosuroides, W. W. Smith, *Ericaceæ* (Notes, Roy. Bot. Gard., Edin., Vol. X (1917), p. 19), Upper Burma.

Cleistanthus Meeboldii, Jabl. *Euphorbiaceæ* (Das Pflanzenreich, Heft 65 (1915), p. 20), Mergui, Tenasserim.

30. **C. travancorensis**, Jabl., *Euphorbiaceæ* (l. c., p., 21), Travancore.

Cornulaca monocantha, Del. *Chenopodiaceæ* (Boiss Fl., Or. IV, 984; Jour. Asiat. Soc., Beng., XV (1919), p. 285), Afghanistan.

Crotalaria Brownei, Bertero, *Leguminosæ* (Jour. Asiat. Soc., LXVI, pt. II (1897), p. 353), Nat. in Chittagong, West Indies.

Daedalacanthus Wardii, W. W. Smith, *Acanthaceæ* (Notes, Roy. Bot. Gard., Edin., Vol. X (1918), p. 174), Upper Burma.

Datura suaveolens, Humb. and Bonpl., *Solanaceæ* (Rec. Bot. Surv., India, Vol. VI (1921), p. 411), Nat. in India, Mexico.

35. **Diospyros Holeana,** Gupta and Kanjilal, *Ebenaceæ* (Ind. For., 1924, p. 255), Nepal border, Gonda Division.

Ellipeia costata, King, *Anonaceæ* (Jour. Asiat. Soc., Beng., Vol. LXI, pt. II (1892), p. 26), Burma.

Eranthemum tapingense, W. W. Smith, *Acanthaceæ* (Notes, Roy. Bot. Gard., Edin., Vol. X (1918), p. 177), Burma.

Euonymus Wardii, W. W. Smith, *Celastraceæ* (Notes, Roy. Bot. Gard., Edin., Vol. X (1917), p. 37), Burma.

Fraxinus Brandisii, Lingelsh *Oleaceæ,* (Das Pflanzenreich, Heft. 72 (1920), p. 56), N.-W. Himalaya, Pangi, Mussoorie.

40. **Gymnosporia Championi,** Dunn, *Celastraceæ* (Kew Bull., 1921, p. 308), United Provinces, Ramnagar Division.

Hydrangea subferruginea, W. W. Smith, *Saxifragaceæ* (Notes, Roy. Bot. Gard., Edin., Vol. XI (1919), p. 212), Upper Burma.

Impatiens cochinica, Hk. f., *Geraniaceæ* (Kew Bull., 1911, p. 355), Cochin.

I. macrocarpa, Hk. f., *Geraniaceæ* (l. c., p. 355), Travancore.

Indigofera Anil, L., *Leguminosæ* (Jour. Asiat Soc., Beng., LXVI (1897), p. 356), Nat. in Burma and the Andamans, S. America.

45. **I. Howellii**, Craib et W. W. Smith, *Leguminosæ* (Notes, Roy. Bot. Gard., Edin., XII (1920), p. 207), Upper Burma.

I. rubro-violacea, Dunn, *Leguminosæ* (Kew Bull., 1922, p. 117), Chamba State, Kashmir.

Jasminum strictum, Haines, *Oleaceæ* (Kew Bull., 1921, p. 310), Plateau of Chota Nagpur.

Lepidagathis Barberi, Gamble, *Acanthaceæ* (l. c., 1923, p. 375), S. India.

Leptodermis kumaonensis, Parker, *Rubiaceæ* (Ind. For., 1922, p. 576), Kumaon.

50. **L. riparia**, Parker, *Rubiaceæ* (l. c., 1924, p. 398), Kumaon

Lysionotus gracilis, W. W. Smith, *Gesneraceæ* (Notes, Roy. Bot. Gard., Edin., Vol. X (1918, p. 186), Upper Burma.

L. Wardii, W. W. Smith, *Gesneraceæ* (l. c., p. 186), Upper Burma.

Machilus robusta, W. W. Smith, *Lauraceæ* (l. c., Vol. XIII (1921), p. 169), Upper Burma.

Magnolia rostrata, W. W. Smith, *Magnoliaceæ* (l. c., Vol. XII (1920), p. 213), Upper Burma, Bhamo.

55. **Mahonia acanthifolia**, G. Don. *Berberidaceæ* (Gen. Syst., Vol. I (1831), p. 118), Nepal, Kumaon, Assam, Darjeeling.

M. borealis, Takeda, *Berberidaceæ* (Notes, Roy. Bot. Gard., Edin., Vol. VI (1917), p. 221), N.-W. India.

M. Griffithii, Takeda, *Berberidaceæ* (l. c., p. 217), Bhutan.

M. Leschenaultii, (Wall.) Takeda, *Berberidaceæ* (l. c., p. 223), Nilgiris, Anamallaya Hills; Ootacamund.

M. manipurensis, Takeda, *Berberidaceæ* (Notes, Roy. Bot. Gard., Edin., Vol. VI (1917, p. 222), Manipur.

60. **M. pycnophylla**, (Fedde) Takeda, *Berberidaceæ* (l. c., p. 218), Khasya.

M. Roxburghii, D. C. Takeda, *Berberidaceæ* (l. c., p. 218), Manipur.

M. sikkimensis, Takeda, *Berberidaceæ* (l. c., p. 200), Sikkim.

M. Simonsii, Takeda, *Berberidaceæ* (l. c., p. 222), Khasya Hills.

Mallotus intercedens, Pax et Hoffm. *Euphorbiaceæ*, (Das Pflanzenreich, Heft. 63 (1914), p. 179, Malabar.

65. **M. pachypodus,** Pax et Hoffm., *Euphorbiaceæ* (l. c., p. 196), Burma.

M. tristis, Pax et Hoffm, *Euphorbiaceæ* (l. c., p. 154), Burma.

Michelia Lacei, W. W. Smith, *Magnoliaceæ*, (Notes, Roy. Bot. Gard., Edin., Vol. XII (1920), p. 216), Upper Burma.

Moringa amara, Durin, *Moringeæ* (Rev. Gen. Bot., XXV (1913), p. 469, in Obs.), Ind. Or.

Mycetia gracilis, Craib., *Rubiaceæ* (Kew Bull., 1914, p. 125), Burma.

70. **Neohouzeaua,** A. Camus, Gen. Nov. *Bambuseæ* (Bull. Mus. Nat. d'Hist. Natur. (1922), p. 100).

N. Helferi, Gamble, *Bambuseæ* (Kew Bull., 1923, p. 91), Burma, Assam.

N. tavoyana, Gamble, *Bambuseæ* (l. c., 1923, p. 92), Burma.

Orophea salicifolia, Hutchinson, *Anonaceæ* (l. c., p. 371), Andaman Islands.

O. torulosa, *Anonaceæ*, (l. c., p. 115), Andaman Islands.

75. **Osbeckia septemnervia,** Ham. Mss. in Herb., Edin. ex Craib, *Melastomaceæ* (Notes, Roy. Bot Gard., Edin., Vol. X (1917, p. 55), Himalaya, Gaulpara.

O. sikkimensis, Craib, *Melastomaceæ* (l. c., p. 56), Himalaya, Sikkim, Darjeeling.

O. Wattii, Craib *Melastomaceæ* (l. c., p. 57), Naga Hills.

Oxyspora serrata, Diels, *Melastomaceæ* (Notes, Roy. Bot. Gard., Edin., V (1912), p. 252), Burma.

Pandanus Wallichianus, Martelli, *Pandanaceæ*, (Webbia IV (1914), p. 435), Burma.

80. **Parastyrax**, W. W. Smith, Gen. Nov., *Styraceæ* (Notes, Roy. Bot. Gard., Edin., Vol. XII (1920), p. 231).

P. burmanicus, W. W. Smith, et Farrer, *Styraceæ* (l. c., p. 233), East Upper Burma.

Pelargonium graveolens, Aiton, *Geraniaceæ* (Fyson's Fl., Nilgiris & Pulney Hill tops (1915), p. 54), Nat. in Nilgiris, S. Africa.

Piper aurorubrum, C. DC., *Piperaceæ* (Fedde. Repert, X (1912), p. 519), Ind. Or., Manipur.

P. crenulatibracteum, C. DC., *Piperaceæ* (l. c., p. 521), Ind. Or., Kanara.

85. **P. kapruanum**, C. DC., *Piperaceæ* (l. c., p. 519), Ind. Or., Manipur.

P. lainatakanum, C. DC., *Piperaceæ* (l. c., p. 519), Ind. Or., Manipur.

P. Meeboldii, C. DC., *Piperaceæ* (l. c., p. 521), Ind. Or., Manipur.

P. magaense, C. DC., *Piperaceæ* (l. c., p. 520), Ind. Or., Manipur.

P. phalangense, C. DC., *Piperaceæ* (l. c., p. 518), Ind. Or., Manipur.

90. **P. Talbotii**, C. D.C., *Piperaceæ* (l. c., p. 523), Ind. Or., Bombay.

Plectranthus Bishopianus, Gamble, *Labiatæ* (Kew Bull., 1924, p. 265), S. India.

P. Bourneæ, Gamble, *Labiatæ* (l. c., p. 264), S. India.

P. Meeboldii, W. W. Smith, *Labiatæ* (Rec. Bot. Surv., India, VI (1914), p. 39) Burma.

Pleurospermum amabile, Craib & W. W. Smith, *Umbelliferæ* (Trans. Bot. Soc., Edin., XXVI (1913), p. 154), Himalaya.

95. **Premna calycina**, Haines, *Verbenaceæ* (Kew Bull., 1922, p. 122), Bengal, Bihar and Orissa and the Central Provinces.

Prosopis glandulosa, Torr, *Leguminosæ* (Ind. For. Records, Vol. IV (1913), p. 20), Nat. in the Punjab and Sind, S. United States and N. Mexico.

Prunus afghana, Cord., *Rosaceæ* (Nat. Syst., Vol. IV (1920), p. 32), Afghanistan.

P. trichantha, Kœhne, *Rosaceæ* (Sargent's Pl. Wilson, I (1913), p. 254), Ind. Or., Sikkim.

Pygeum anomalum, Kœhne, *Rosaceæ* (Engl. Jahrb., LI (1913), p. 183), Burma, Tenasserim.

100. **P. ciliatum**, Kœhne, *Rosaceæ* (l. c., p. 184), Assam.

P. ocellatum, Kœhne, *Rosaceæ* (l. c., p. 184), Assam.

Pyrus bhutanica, W. W. Smith, *Rosaceæ* (Rec. Bot. Surv., India, IV (1911), p. 265), Tibet and Bhutan, Himalaya.

Rauwolfia canescens, L. *Apocyanaceæ* (Gamble's Mad. Fl. (1923), p. 808), Nat. in S. India, W. Indies.

Rhamnus cachemirica, Gandoger, *Rhamnaceæ* (Bull. Soc. Bot. France, LX (1913), p. 458), Kashmir.

105. **Rhododendron æmulorum**, Balf. f., *Ericaceæ* (Notes Roy. Bot. Gard., Edin., Vol. XII (1920), p. 86), N.-E. Upper Burma.

R. agapetum, Balf. f. et Ward, *Ericaceæ* (l. c., Vol. XI (1919), p. 212), E. Upper Burma.

R. aiolosalpinx, Balf. f. et Farrer, *Ericaceæ* (l. c., Vol. XIII (1922), p. 227), N. E. Upper Burma.

R. aperantum, Balf. f. et Ward, *Ericaceæ* (l. c, p. 231), N. E. Burma.

R. argipeplum, Balf. f. et Cooper, *Ericaceæ* (l. c., p. 231), Bhutan.

110. R. arizelum, Balf. f. et Forrest, *Ericaceæ* (Vol. XII (1920), p. 90), N. E. Upper Burma.

R. brachystylum, Balf. f. et. Ward, *Ericaceæ* (l. c., Vol. XIII (1922), p. 236), N. E. Burma.

R. brevitubum, Balf. f. et Cooper, *Ericaceæ* (l. c., Vol. X (1917), p. 88), Bhutan.

R. calostrotum, Balf. f. et Ward, *Ericaceæ* (l. c., Vol. XIII (1920), p. 35), N. E. Upper Burma.

R. caloxanthum, Balf. f. et Farrer, *Ericaceæ*, (l. c., Vol. XIII (1922), p. 238, N. E. Upper Burma.

115. R. cerinum, Balf. f. et Farrer, *Ericaceæ* (l. c., p. 240), N. E. Upper Burma.

R. charidotes, Balf. f. et Farrer, *Ericaceæ* (l. c., p. 242), N. E Upper Burma.

R. charitopes Balf. f. et Farrer, *Ericaceæ* (l. c., p. 243), N. E. Upper Burma.

R. charitostreptum, Balf. f. et Ward, *Ericaceæ* (l. c., p. 244), N. E. Upper Burma.

R. charopoeum, Balf. f. et Farrer, *Ericaceæ*, (l. c., p. 245), N. E. Burma.

120. R. chawchiense, Balf. f. et Farrer, *Ericaceæ* (l. c., p. 247), N. E. Upper Burma.

R. coelicum, Balf. f. et Farrer, *Ericaceæ* (l. c., p 250), N. E. Upper Burma.

R. commodum, Balf. f. et Forrest, *Ericaceæ* (l. c., p. 252), N. E. Upper Burma.

R. Cooperi, Balf. f. *Ericaceæ* (l. c., Vol. X (1917), p. 91), Bhutan.

R. cremnastes, Balf. f. et Farrer, *Ericaceæ* (l. c., Vol. XIII (1922), p. 253), N. E. Upper Burma.

125. **R. Cubittii,** Hutchinson, *Ericaceæ* (l. c., Vol. XII (1919) p. 78), North Burma.

R. euchroum, Balf. f. et Ward, *Ericaceæ* (l. c., Vol. IX (1916), p. 228), E. Upper Burma.

R. dendricola, Hutchinson, *Ericaceæ* (l. c., Vol. XII (1919), p. 60), N. Burma.

R. epapillatum, Balf. f. et Cooper, *Ericaceæ* (l. c., Vol. XIII (1922), p. 257), Bhutan.

R. facetum, Balf. f. et Ward, *Ericaceæ* (l. c., Vol. X *(1917), p. 104), E. Burma.*

130. **R. haemonicum,** Balf. f. et Cooper, *Ericaceæ* (l. c., Vol. IX (1916), p. 233), Bhutan.

R. heptamerum, Balf. f. *Ericaceæ* (l. c., Vol. XIII (1920), p. 48), N. E. Upper Burma.

R. herpesticum, Balf. f. et Ward, *Ericaceæ* (l. c., Vol. X (1917), p. 114), E. Upper Burma.

R. hylæum, Balf. f. et Farrer, *Ericaceæ* (l. c., Vol. XIII (1922), p. 265), E. Upper Burma.

R. hypenanthum, Balf. f. *Ericaceæ* (l. c., Vol. IX (1916), p. 291) Himalaya.

135. **R. hypolepidotum,** Balf. f. et Forrest, *Ericaceæ* (l. c., Vol. XIII (1922), p. 266), E. Upper Burma.

R. jenestierianum, G. Forrest, *Ericaceæ* (l. c., Vol. XII (1920), p. 122), N. E. Upper Burma.

R. Kyawi, Lace et W. W. Smith, *Ericaceæ* (l. c., Vol. VIII (1914), p. 216), Burma.

R. lithophilum, Balf. f. et Ward, *Ericaceæ* (l. c., Vol. XIII (1922), p. 275), N. E. Burma.

R. Macabeeanum, Watt, Mss., *Ericaceæ* (l. c., Vol. XII (1920), p. 128), Manipur, Naga Hills.

140. R. **Mackenzianum,** G. Forrest, *Ericaceæ* (l. c., p. 132), N. E. Burma.

R. **mallotum,** Balf. f. et Ward, *Ericaceæ* (l. c., Vol. X (1917), p. 118), E. Upper Burma.

R. **manipurense,** Balf. f. et Watt, *Ericaceæ* (l. c., p 119), Manipur.

R. **megacalyx,** Balf. f. et Ward, *Ericaceæ* (l. c., Vol. IX (1916), p 246), E. Upper Burma.

R. **myrtilloides,** Balf. f. et Ward, *Ericaceæ* (l. c., Vol. XIII (1922), p. 276), N. E. Burma.

1 5 R. **niphobolum,** Balf. f. et Farrer, *Ericaceæ* (l. c., p. 277) E. Burma.

R. **nwaicense,** Balf. f. et Ward, *Ericaceæ* (l. c., Vol. IX, (1916), p. 252), E. Upper Burma.

R. **ombrochares,** Balf. f. et Ward, *Ericaceæ* (l. c., Vol. XIII (1922), p. 280), N. E. Upper Burma.

R. **oparinum,** Balf. f. et Ward, *Ericaceæ* (l. c., Vol. X (1917), p. 129), E. Upper Burma.

R. **oulotrichum,** Balf. f. et Forrest, *Ericaceæ* (l. c., Vol. XIII (1922), p. 281), N. E. Upper Burma.

150. R. **papillatum,** Balf. f. et Cooper, *Ericaceæ* (l. c., p. 282) Bhutan.

R. **phaedropum,** Balf. f. et Farrer, *Ericaceæ* (l. c., p. 283), N. E. Upper Burma.

R. **phoenicodum,** Balf. f. et Farrer, *Ericaceæ* (l. c., p. 285), N. E. Upper Burma.

R. **polyandrum,** Hutchinson, *Ericaceæ* (l. c., Vol XII (1919), p. 25), Bhutan.

R. **preptum,** Balf. f. et Forrest, *Ericaceæ* (l. c., Vol. XII (1920), p. 149), N. E. Upper Burma.

155. R. **prophantum,** Balf. f. et Forrest, *Ericaceæ* (l. c., Vol. XIII (1922), p. 58), N. E. Upper Burma.

R. **regale,** Balf. f. et Ward, *Ericaceæ* (l. c., Vol. XII (1920), p. 156), N. E. Upper Burma.

R. rhabdotum, Balf. f. et Cooper, *Ericaceæ* (l. c., Vol. X (1917), p. 141), Bhutan.

R. sciaphilum, Balf. f. et Ward, *Ericaceæ* (l. c., p. 146), E. Burma.

R. scyphocalyx, Balf. f. et Forrest, *Ericaceæ* (l. c., Vol. XIII (1922), p. 291), N. E. Upper Burma.

160. **R. siolereum**, Balf. f. *Ericaceæ* (l. c., Vol. XII (1920), p. 162), N. E. Burma.

R. sperabile, Balf. f. et Farrer, *Ericaceæ* (l. c., Vol. XIII (1922), p. 297), N. E. Upper Burma.

R. spilotum, Balf. f. et Farrer, *Ericaceæ* (l. c., p. 298) N. E. Upper Burma.

R. spodopeplum, Balf. f. et Farrer, *Ericaceæ* (l. c., p, 299), N. E. Burma.

R. tapeinum, Balf. f. et Farrer, *Ericaceæ* (l. c., Vol. XII (1920), p. 164), N. E. Upper Burma.

165. **R. tephropeplum**, Balf. f. et Farrer, *Ericaceæ* (l. c., Vol. XIII (1922), p. 302), N. E. Upper Burma.

R. thyodocum, Balf. f. et Farrer, *Ericaceæ* (l. c., Vol. XI (1919), p. 148), Bhutan.

R. torquatum, Balf. f. et Farrer, *Ericaceæ* (l. c., Vol. XIII (1922), p. 303), N. E. Upper Burma.

R. zaleucum, Balf. f. et W. W. Smith, *Ericaceæ* (l. c. Vol. X (1917), p. 163), E. Upper Burma.

Rubus almorensis, Dunn, *Rosaceæ* (Kew Bull., 1921, p. 310), United Provinces; Almora.

170. **R. potentilloides**, W. F. Evans, *Rosaceæ* (Notes, Roy. Bot. Gard., Edin., Vol. XIII (1921), p. 179), Upper Burma.

Sabia Wardii, W. W. Smith, *Sabiaceæ* (l. c., Vol. X, (1917), p. 64), N. Burma.

Sambucus Hookeri, Rehder, *Caprifoliaceæ* (Sargent Pl. Wilson, I (1913), p. 308), Ind. Or. Sikkim.

Sauropus concinnus, Coll. et Hemsl. *Euphorbiaceæ* (Das Pflanzenreich, Heft 81 (1922), p. 224), Upper Burma.

Skimmia melanocarpa, Rehder and Wilson, *Rutaceæ* (Sargent Pl. Wilson II (1914), p. 138), Sikkim.

175\. **Solanum sisymbriifolium,** Lamk. *Solanceæ* (Gamble's Mad. Fl. (1923), p. 938). Nat. in many parts of India, S. America.

S. robustum, Wendl. *Solanaceæ* (l. c., p 938), Nat. in Nilgiris, S. America.

Sorbus arachnoidea, Kœhne, *Rosaceæ* (Fedde Repert X (1912), p. 154), Sikkim.

S. Wattii, Kœhne, *Rosaceæ* (l. c., p. 515), Burma.

Spiraea diversifolia, Dunn, *Rosaceæ* (Kew Bull., 1921, p. 309), United Provinces, East Almora.

180\. **S. Wardii,** W. W. Smith, *Rosaceæ* (Notes, Roy. Bot. Gard., Edin., Vol. X (1917), p. 68), Upper Burma.

Sporoxeia, W. W. Smith, Gen. Nov., *Melastomaceæ* (l. c., Vol. X (1917), p. 69).

S. sciadophila, W. W. Smith, *Melastomaceæ* (l. c., p. 70), Upper Burma.

Stereospermum angustifolium, Haines, *Bignoniaceæ*, (Kew Bull. (1922), p. 121), Central Provinces, Angul Sambalpur.

Strobilanthes arenicolus, W. W. Smith, *Acanthaceæ*, (Notes, Roy. Bot. Gard., Edin., Vol. X (1918), p. 190), Upper Burma.

185\. **S. circarensis,** Gamble, *Acanthaceæ* (Kew Bull., 1923 p. 323), S. India.

S. Lawsoni, Gamble, *Acanthaceæ* (l. c., p. 374), S. India.

S. oresbius, W. W. Smith, *Acanthaceæ* Notes, Roy. Bot. Gard., Edin., Vol. X (1918), p. 196), Upper Burma.

S. stramineus, W. W. Smith, *Acanthaceæ* (l. c., p. 200), Upper Burma.

S. urceolaris, Gamble, *Acanthaceæ* (Kew Bull., 1923, p. 374), S. India.

190. **S. Wardii**, W. W. Smith, *Acanthaceæ* (Notes, Roy. Bot. Gard., Edin., Vol. X (1918), p. 201), Upper Burma.

Styrax Buchananii, W. W. Smith, *Styraceæ* (l. c. Vol. XII (1920), p. 234), Upper Burma, Bhamo District.

Syringa afghanica, C. K. Schneider, *Oleaceæ* (Wien. Ill. Gartenzeit, 1903, p. 106, in Obs. Ill. Handb, Laubholzk. ii (1911) p. 775), Afghan.

Thevetia neriifolia, Juss. *Apocynaceæ* (Gamble's Mad Fl. (1923), p. 821), Nat. in S. India, S. America.

Thunbergia adenophora, W. W. Smith, *Acanthaceæ*, Notes, Roy. Bot. Gard., Edin., Vol. X (1917) p. 747, Burma.

195. **Uraria pulchra**, Haines, *Leguminosæ* (Kew Bull., 1921, p. 308), Sameshwar Hills; borders of Nepal.

Vaccinium oreogenes, W. W. Smith, *Vacciniaceæ*, (Notes, Roy. Bot. Gard., Edin., Vol. XII (1920), p. 227), Upper Burma.

Viburnum Wardii, W. W. Smith, *Caprifoliaceæ* (l. c., Vol. X (1917), p. 77), E. Upper Burma.

LIST OF SPECIES NOT INCLUDED IN INDEX KEWENSIS.

1. **Acacia Balfouri**, Woodrow, *Leguminosæ* (Jour. Bomb. Nat. Hist. Soc., Vol. XI (1898), p. 429), Nat. in Western India, Socotra.

Aglaia littoralis, Talb., *Meliaceæ* (Talb. List Trees, Shrubs Bomb. Pres., (1902), p. 76), Konkan and N. Kanara.

Ardisia parviflora, Talb. *Myrsinaceæ* (l. c., p. 204), N. Kanara.

Chasalia virgata, Talb., *Rubiaceæ* (l. c. (1894), p. 114), N. Kanara.

5. **Dysoxylum glandulosum**, Talb. *Meliaceæ* (Jour. Bomb. Nat. Hist. Soc., Vol. XI (1898), p. 699), N. Kanara.

Eugenia kanarensis, Talb., *Myrtaceæ* (l. c., XI (1897), p. 236), N. Kanara.

E. memecylifolia, Talb., *Myrtaceæ* (l. c., p. 236), N. Kanara.

E. utilis, Talb., *Myrtaceæ* (l. c., p. 235), N. Kanara.

Lasianthus sessilis, Talb., *Rubiaceæ* (Talb. Sys. List Trees, Shrubs Bomb. Pres. (1894), p. 114), N. Kanara.

10 **Loranthus gibbosus,** Talb. *Loranthaceæ* (l. c., (1902), p 289), Konkan and N. Kanara.

Pyschotria canarensis, Talb., *Rubiaceæ* (l. c., (1894), p 113) N. Kanara.

P. flavida, Talb. *Rubiaceæ* (l. c., p. 113), N. Kanara.

P. octosulcata, Talb., *Rubiaceæ* (Jour. Bomb. Nat. Hist. Soc., Vol. XI (1897), p. 237), N. Kanara.

14. **Symplocos kanarana,** Talb., *Styraceæ* (l c., p. 238), N. Kanara.

The following names are invalid under the International rules :—

1 *Arundinaria Phar*, E. G. Camus, *Bambuseæ* Les Bambusees (1913), p. 37), Lushai Hills.

Bambusa Kyathaungtu, E. G. Camus, *Bambuseæ* (l. c., p. 116), Burma.

Carissa gangetica, Stapf. in Herb. Kew, *Apocynaceæ* (Gamble's Mad. Fl. *(1923), p. 805), S. India.*

Diospyros sulcata, Bourd. *Ebenaceæ* (Bourd. For. Trees ; Trav. (1908), p 255), Travancore.

Eugenia Mundagam, Bourd. *Myrtaceæ* (l. c., p. 182), Travancore.

Gigantochloa Kachinensis, E. G. Camus, *Bambuseæ* (Les Bambusees (1913), p. 141), Burma.

G. Kathænsis, E. G. Camus, *Bambuseæ* (l. c., p. 141), Burma.

G. Mogaungensis E. G. Camus, *Bambuseæ* (l. c., p. 141), Burma.

G. Tekserah, E. G. Camus, *Bambuseæ* (l. c., 141), Burma.

10. *G. Toungooensis*, E. G. Camus, *Bambuseæ* (l. c., p. 140), Burma.

G. Wanet, E. G. Camus, *Bambuseæ* (l. c., p. 141), Burma,

G. Wunthœnsis, E. G. Camus, *Bambuseæ* (l. c., p. 141), Burma.

G. Yunzabinensis, E. G. Camus, *Bambuseæ* (l. c., p. 141), Burma.

Grewia Barberi, J. R. Drummond, *Tiliaceæ* (Gamble's Fl. Mad. (1915), p. 118), Madras.

15. *G. Gamblei*, J. R. Drummond, *Tiliaceæ* (l. c., p. 117), Madras.

G. Lawsoniana, J. R. Drummond, *Tiliaceæ* (l. c., p. 117), Madras.

G. pandaica, J. R. Drummond, *Tiliaceæ* (l. c., p. 119), Madras.

Hemicyclea travancorica, Bourd, *Euphorbiaceæ* Bour. For. Trees, Trav. (1908), p. 329), Travancore.

Phyllostachys Bawa, E. G. Camus, *Bambuseæ* (Les Bambusees (1913), p. 66), Burma.

20. *P. Sedam*, E. G. Camus, *Bambuseæ* (l. c., p. 66), Burma.

R. N. PARKER,
Forest Botanist
and
B. L. GUPTA,
Asstt. to Forest Botanist.

DEHRA DUN:
20th September 1924.

ENDLESS TRACK UNITS FOR FOREST TRANSPORT.

In many parts of the world conditions are such that the efficient operation of mechanical vehicles of any sort presents considerable difficulties. At the same time animal power is wasted in dragging wheeled vehicles over badly rutted routes or soft ground. To meet these conditions Messrs. Roadless Traction, Ltd., are now marketing a Roadless unit which is interchangeable with the wheels of bullock carts and wagons, timber drags, the heavier types of trailers, etc. These units are fitted in place of wheels on the existing axles of the vehicle, special bushes to suit the particular size and type of axle, being supplied, with

the units. The conversion can be effected in a few hours by any moderately intelligent workman. Alternatively wagon builders can obtain the units complete with tubular axles if desired.

The advantage of these units is that over almost any given route the number of animals required to haul the load can be halved. As might be expected, these endless track units do not sink as the wheel does in soft ground or sand, nor is the route cut up and rutted, so that the rolling resistance of the vehicle progressively decreases. In addition, even on good roads, the rolling resistance is reduced to about half that of the wheeled wagon or trailer. Where good roads are available, therefore, Roadless units can still be employed with immense advantage.

Full particulars and prices of these units are available on application to Messrs. Roadless Traction Ltd., Gunnersbury House, Hounslow, Middlesex. In the near future arrangements will be made so that stocks will be carried in all the principal countries and cities of the world.

The price is £35 per unit nett., packed and delivered F. O. B., London Port. These units are equally applicable to single axle vehicles such as the Indian type bullock wagon.

THE AMERICAN LUMBER INDUSTRY.

REVIEW: THE AMERICAN LUMBER INDUSTRY, by NELSON COURTLANDT BROWN, B.A., M.F., New York—John Wiley and Sons, Inc.: London—Chapman and Hall, Ltd., 1923, I—XVIII; 1—279; figs. 1—36. Price 15*s.* net.

The subject of this book is such a vast one that its treatment would seem to demand an encyclopædia rather than a modest volume of some 280 pages, but Mr. Brown has succeeded in condensing into this space a very useful conspectus of the varied aspects of the industry.

In view of the preponderating importance of softwood, *i.e.* coniferous timber, in the wood-using industries of America and the world generally, this side of the lumber industry receives most attention from the author, which deprives the book of some of the interest which more details as to the hardwoods would have given it for readers in the tropics, but there is still plenty to be found in it for all readers.

For the general reader we would particularly recommend a study of the first two chapters, the price statement on page 134 and the chart on page 252 which shows the percentage of wood actually made use of from a tree. The comparison between the per capita consumption of the various countries should give food for thought to many. It also brings out the immense demands which modern civilisation makes on the forests of the world even in those countries where the lack of home grown timber has forced a certain measure of economy on the inhabitants. When one considers that England in spite of the development of wood substitutes uses some nine hundred million cubic feet of timber per annum, the ultimate demand of India as industries develop promises to be far in excess of the probable yield of her forests.

Perhaps the most striking point brought out by this book is the advantage of a general organisation of the timber industry which in the case of America appears to have not only made trading easier between different parts of the country, but to have brought about an actual economy in the manufacture of timber. It is too much to expect that the small timber dealer in India will take this to heart but there is no reason why the larger consumers such as the railways and the Public Works Department should not take up the question of standardising sizes and grades. Constructional engineers all over India might well read Chapter VI and consider whether there is not a real advantage to be obtained in standardising the defects admissible in timber for general use. In this respect India is in a better position than America. Highly specialised wood-using industries have not developed in various parts of the country to the extent that forty-nine grades of one

timber have become accepted and can only be given up at some expense in dislocation of the industry.

Marketing and Distribution are dealt with in considerable detail, but these sections though interesting in showing the intricacy of the timber business in America have not a great bearing on India's problems. One may imagine that most Indian traders would be aghast at the prospect of earning such a small percentage on their money as their opposite numbers in America have to content themselves with. The $8\frac{1}{2}$—9 per cent. earned by the southern pine companies would hardly attract the chetty sawmill owner or the local money-lender as an investment.

Therein lies the problem of India's timber trade. Can it be built up on a basis of 12—24 per cent. loan money?

SOIL ACIDITY AND ITS RELATION TO AMMONIFICATION AND NITRIFICATION IN WOODLAND SOILS.

SOIL ACIDITY AND ITS RELATION TO THE PRODUCTION OF NITRATE AND AMMONIA IN WOODLAND SOILS, by G. R. CLARKE, B.A., B.SC., Research Scholar of Oriel College, Oxford Forestry Memoir, No. 2. (Clarendon Press, 1924, pp. 27, Figs. 12, price *3s. 6d.*)

The close relation between the plant and its habitat is well known. The climate and the characteristics of the soil of a particular region determine the natural vegetation, the survivors being those which are best adapted to the entire environment, and the very form and development of the trees being correlated to the edaphic conditions. For example, it has long been known that the reaction of the soil is an important factor in the distribution of agricultural plants and forest trees. For each kind of plant there is specific reaction range over which its growth is most successful.

It may not be out of place here to point out that there is a distinction between two aspects of soil acidity. The total acidity of a soil is a quantity factor and is measured by the amount of base which must be added to the soil to combine with the whole amount of acid present. The active acidity of the soil,

the concentration of the hydrogen-ions, is, on the other hand, a measure of the intensity factor of soil acidity. There need be no direct relationship between these two as any comparison would be a comparison between the measurement of two distinct factors. This point may perhaps be made clear thus. A particular dilution of lime juice may be found to be so strong as to set the teeth on edge. But the addition of salt to it improves matters and makes it taste less sour than it is before the addition. The total amount of acid present in the solution is the same as before, but the intensity of sourness becomes modified in the presence of salt.

Considerable attention is being given in recent years to the relation of soil acidity to plant growth. It is of practical utility to find out the optimum reaction ranges for the cultivated plants, so that suitable soils may be selected for particular crops or that even the soil reaction may be adjusted by the application of the proper soil amendments. Some amount of work is also being done in the case of the forest flora. It is of interest to quote here the result of Olsen's researches in Denmark on the significance of soil acidity to the vegetation, especially the natural distribution of plants. The hydrogen-ion concentration appeared to have an essential influence on the composition of the plant formations, as single species only were found in soils the hydrogeni-on concentration of which lay within a certain range characteristic of each single species. Within this range there was found a narrower range in which the species had its greatest average frequency.

In the correlation between soil types, and forest types and plant associations, the activity of the micro-flora of the soil is a very significant factor. Of the numerous bacteria in the soil which take part in the elaboration of plant food materials, those which bring about ammonification and nitrification are of great importance. Though plants obtain slight amounts of nitrogen from other sources, they obtain by far the greater portion from the soil in the form of nitrate. A study of the activities of these bacteria as related to hydrogen-ion concentration is thus of great value and Mr. G. R. Clarke's memoir is very opportune.

The author begins with a résumé of the more important literature on the subject, and after briefly discussing the cause of soil acidity describes the methods of analysis adopted by him. The concentration of hydrion was determined by Gillespie's method, and the lime requirement measured by Hutchinson and McLennan's method. The estimation of Ammonia was made by Mathew's method. The "loss on ignition" figure was taken to present the organic content of the soil. This loss in weight, as is known, is due to the escape of water and carbon dioxide as also to the combustion of humus and the unhumified plant residues, the influence of which last on soil conditions is not at all so profound as that of humus. The loss in weight is thus not due solely to the disappearance of organic matter. But it is necessary in ecological technique to restrict the procedure to relatively simple processes. Moreover, the present state of our knowledge of the organic substances existing in the soil is still very incomplete. It is therefore difficult to devise a satisfactory substitute for the empirical method of estimating organic matter by the loss on ignition. In special instances where this method is obviously inapplicable, *e.g.* in the case of highly calcareous Pusa soils, the writer of this review found that significant figures about the humus content are obtainable by the relatively simple process of colorimetric comparisons of soil extracts.

The determination of nitrates was done by the phenol-disulphonic acid method. This method is very convenient and does not give any trouble in the case of normal soils. But when applied to soils having a large amount of decomposing organic matter the extract is highly coloured. The yellow colour noticed in the case of the acid soils has been thought by Mr. Clarke to be due to the lack of lime in the soil. This does not appear to be correct as he found that some of the solutions were not clear even when the soils were extracted in the presence of finely divided calcium carbonate. Moreover the reviewer experienced the same trouble in the case of some heavily dunged Pusa soils which are very rich in calcium carbonate. The difficulty was overcome at Pusa by the addition of lime to the

extract whereby the colloids are flocculated and the colouring matter removed from the solution. It is interesting to find that the same procedure was adopted by Mr. Clarke in his present researches.

The soils studied by Mr. Clarke were taken from Bagley Wood near Oxford. The results showed that—

(*a*) There is a definite relationship between the Lime Requirement of a soil and its organic content.

(*b*) The pH value of a soil growing a forest crop is least acid when the crop is in full growth.

(*c*) The accumulation of ammonia is greater in very acid soils than it is in slightly acid and neutral soils.

(*d*) The ammonia of a very acid soil is liable to rapid fluctuation.

(*e*) The soil shows a great retentive power for ammonia when in certain conditions of moisture content.

(*f*) Nitrate is present in measureable quantities in very acid soils, and is apparently independent of seasonal changes under the conditions of these investigations.

The author is to be congratulated on his useful publication.

J. S.

INDIAN BIRDS.

REVIEW : BIRDS OF AN INDIAN GARDEN, by T. BAINBRIGGE FLETCHER and C. M. INGLIS. IN five parts. Price Rs. 2 per part ; 1924. *Thacker Spink & Co.*

Though much has been written on Indian Birds, no popular book has yet appeared dealing at least with the commoner birds with coloured illustrations of every species dealt with. There is an undoubted demand for such a work.

A large number of the European residents and visitors in this country, as well as many Indians take a real interest in birds, but they are discouraged by the fact that the standard works on Indian ornithology, *viz.*, Jerdon's Birds of India and the four volumes of the Fauna of British India treating of birds are not

provided with illustrations. Moreover the former work is completely out of date and both it and the Fauna of British India are expensive and difficult to obtain.

Douglas Dewar has written several books on Indian birds which are excellent in their way but they lack one great essential to popularity, *viz.*, coloured illustrations.

The present work is a beginning in the right direction, but it only deals with 30 birds (Part I describes and figures 6 birds only). Whereas what is really required is a comprehensive work treating of at least all the birds most frequently met with in the plains and hills of India.

Part I of the work now under reference is a very good commencement. The letter-press is excellent and the coloured illustrations generally good, though a little hard. The Jungle Crow in Plate I is a little too stout, and its nest and eggs are not very good. The Indian House Crow (Plate II) is much better. The Bengal Tree Pie (Plate III) is also good but the beak of the bird is hardly stout enough. The Seven Sisters (Plate IV) are well drawn but the colouring is not correct. The birds should be *ashy brown* and not rufous brown as is depicted. The Red-vented Bulbul (Plate V) is excellent, as is also the King Crow (Plate VI), though in the last plate the King Crow chasing the Lagger Falcon in the near distance should have been drawn smaller in comparison with the falcon, a bird several times its size.

The book will undoubtedly help to fill a longfelt want, and we hope it may be possible to extend it to a much larger number of species in the future.

EXTRACTS.

EUCALYPTIAN FACTS.

Eucalypts will not regenerate or develop in shade; they demand the full sunshine and are classed as intolerant, or strong light demanders; they *spring up in exposed places more or less* directly from the mineral sub-soil; as seedlings they assert them-

selves immediately and gain dominance by extraordinary rapid height growth; as poles they extend in open order through the forest, and as veterans they stand in the light of everything else.

Because of their wide spacing there is ample room beneath them for other species; the shade they cast is not heavy, scarcely heavy enough indeed to oust grass, itself a fierce light demander; their litter of leaf and bark, however, tends to extinguish grass growth but produces its own antidote of bush fires which aids grass to ascendency by disposing of the encumbering débris and by thinning the Eucalyptian canopy......

The essentials of *Eucalyptus* regeneration are—

(*a*) A clear opening of sufficient extent;

(*b*) A regeneration fire to (1) destroy caterpillars and grass-hoppers which would eat the cotyledonary seedlings, (2) provide an ash-barrage against ant attack, (3) furnish a suitable level seed bed of fine tilth, (4) repress root competition from ground shrubbery, (5) eliminate soil acidity;

(*c*) Ample supplies of seed from adjoining standing trees, from ringbarked trees on the opening, or from the ground if it were true that the seed remained stored there and survived the regeneration fire or were unburdened by it of overlying litter and vegetation;

(*d*) Sufficient rainfall at the right time;

(*e*) Protection against (1) suppression by coppice shoots, or other vegetation; (2) falling limbs from the dead canopy overhead; (3) *succeeding fires.*

The question of fire protection, therefore, is bound up intimately with the problem of Eucalypt regeneration. Fire must be used for regeneration purposes and not afterwards. Yet fire is a natural consequence of the *Eucalyptus* forest conditions of dry sites and dry underwoods and dry undergrowth, open stands and grass.

The matter of fire protection further is a matter of grazing control and we are reduced to the proposition of a *Eucalyptus-cum*-grass mixture, with grazing control.

Graziers insist on periodical firing for grass production; periodical fires damage Eucalypt regrowth and undo all the good that they do in the regeneration phase.

The Western Australia Department of Forestry is applying itself fruitfully to the problem and has secured very interesting results. Briefly, the system it has evolved thus far is as follows :—

(*a*) The forest is divided into logging blocks;

(*b*) The miller is awarded a logging block more or less equal to the periodic capacity of his mill, and to be cut out as thoroughly as possible before being granted a new block;

(*c*) A light fire is run through each cutting area by the Forest Department prior to felling operations by the miller. This can only be done when the weather warrants and will apply only to the area to be cut over during the current year;

(*d*) The Forest Department workmen follow the fallers and clear the débris for a distance of about three feet from around the trees and poles it is desired to protect. Limbs which stick up from the fallen trees and are likely to carry fire into the tops of adjacent trees are lopped;

(*e*) The crowns of fallen trees are burnt as soon as possible after the débris has been removed from around the trees requiring protection. The burning of the inflammable leaves and branchlets suffices.

Queensland procedure is similar. It is preferable for the Forest Service to arrange its own felling (on contract) subject to the conditions :—

(1) Forest Service controlled creeping fires to precede felling wherever such can be managed;

(2) Fallers to cut in a face within the confined limits of a block or compartment and to clear all débris 3 ft. (at least) away from useful immature growth (only) left behind; sleepergetters and girdergetters similarly;

(3) Forest Service to inspect and complete removal of all merchantable growth ; *ringbark useless trees and burn* off the inflammable débris of the workings immediately after the felling.

Thereafter fire protection is vital. The fire plan will take four forms—

(1) Fire season lookout and patrol with instant detection, location and suppression as the objectives.

(2) Fire beating from the tail pinching in the sides to the head ;

(3) Fire protection propaganda and co-operation as between settler and forest officer ;

(4) Fire belt burning off around regeneration areas, plus road fire brake planning.

Eucalypt regeneration develops rapidly after establishment, the stand of seedlings is extremely dense, but thins out rapidly because of its intolerance to shade this natural thinning should be aided by artificial thinnings in the pole stage and a very open stand of full-crowned poles developed when the underwood and undergrowth may be reduced to grass to be heavily stocked and periodically burned over by slow-creeping Forest Service controlled fires (preceded by removal of débris from around the base of desirable trees).—[*E. H. F. Swain, Director of Forests* in *Queensland Agricultural Journal, January 1924.*]

CHIENGMAI LACQUER WARE.

The basis of the lacquer used in Chiengmai*, as of that of Burma, is the resin of the *rak* tree (*Melanorrhœa usitata*). In China and Japan lacquer is made from the resin of other, though nearly related trees.

The *rak* tree is fairly common throughout the greater part of Siam; it is found in that type of dry deciduous forest known in the South as *pa dêng*, in the North as *pa pê*, and ranges in altitude from near sea level to about 4,000 feet.

* Chiengmai is the chief town of Northern Siam and is the centre of the northern teak trade.

Rak resin is chiefly used for making lacquer ware but it is also employed for waterproofing bamboo-woven vessels intended to hold water. The resin sometimes produces inflammatory skin eruptions on those who handle it; individuals vary greatly in their susceptibility to this irritating action, some can handle it with impunity while others are so affected that they dare not touch it. It may be mentioned here that a mixture of *rak* resin and teak sawdust has some reputation among the Laos as a remedy for leprosy. Teak sawdust is also used to allay the irritation caused by handling the resin.

The resin can be collected throughout the year but the best times for doing so are at the end of the rains and in the hot season. If collected during the rains the resin gets mixed with débris washed down from the trunk of the tree, while in the flowering season, about December and January, the yield of resin is very poor.

The resin is obtained by making V-shaped incisions in the bark of the tree, a bamboo joint to receive the resin which flows from the incisions being stuck into the bark at the bottom of the V. On a good tree 20—30 of these incisions may be made at one time. The resin continues to flow for seven or eight days when the bamboo joints are taken down and the resin they contain emptied into a larger vessel. A thin layer of water is poured over the surface of the resin to keep it from drying up. When fresh the resin is of a reddish black colour, when dry it is a pure glistening black.

Three qualities of resin, depending on the season of collection are recognised, they are—

(1) *Rak ki kwai*, a poor quality resin, collected in the rains.

(2) *Rak dêng*, a resin of good quality, collected at the end of rains.

(3) *Rak nam nai*, considered the best resin, collected during the hot season.

Adulterants are sometimes used; the commonest are water and the oil of the *vang* tree (*Dipterocarpus alatus* and *D. turbinatus*). One method of testing the resin is to thrust a stick into it, if there are no impurities the stick comes out evenly

coated with a smooth glistening layer of resin, if, on the other hand, the stick comes out only coated in patches, or without the smooth glistening appearance, it is adjudged that adulterants have been used.

A great part of the resin used in Chiengmai is brought down from the neighbourhood of Muang Hang in the Shan States, some also comes from the regions of Doi Saket and Me Wang in the province of Chiengmai. Good resin fetches about 18 ticals for a kerosene tin full ; the price, however, varies somewhat from season to season and from year to year.

A small amount of lacquer ware, chiefly for personal use and usually rather roughly finished, is made in various parts of Northern Siam by Laos, Shans and Karens. Chiengmai is, however, the only place where there is a large output of lacquer for trade purposes.

The manufacture of this lacquer ware probably goes back hundreds of years. One family in Chiengmai has been engaged in the business for at least five generations ; the oldest living member of this family is 86 and still well though now past active work. Most of the Chiengmai lacquer workers, like other special craftsmen, are congregated in one neighbourhood, the Pratu Chiengmai. The articles commonly manufactured are round betel-boxes, bowls, trays, cigarette cases and water bottles. Large pieces of furniture, such as chair, tables and cabinets are also turned out, but only when specially ordered.

The characteristic Chiengmai ware is black and red but a good deal of black and gilt is also made. Of recent years other colours have been used but these are obtained by applying oil colours over the lacquer. An ordinary piece of black and red lacquer, that is red lines on a black background, has to go through a number of processes and requires three weeks or more for its completion. Very fine lacquer work has to be treated with much greater care and takes longer to finish, one piece may occupy some six or seven weeks in the making. This very fine work is not seen in the market and is only made to special order.

Woven bamboo is the foundation of most of the lacquer ware but solid wood is also used. The commonest form of these wooden

articles is a round tray. These trays are made from the wood of various trees, chiefly *mai tun ten* (*Duabanga sonneratioides*) and *mai wit* (*Garuga pinnata*). The woodwork of these trays is completed in villages outside Chiengmai. They are first roughly shaped with a knife and then finished off on a simple lathe; one man can turn some 10 to 15 trays in a day. The trays when turned are taken to Chiengmai and there sold to the lacquer workers at the rate of about 18 ticals for a hundred trays. These trays when lacquered are usually finished off in plain red.

As already mentioned the bulk of the lacquer ware is on a foundation of woven bamboo. The bamboos used for this purpose are *mia hia* (*Cephalostachyum pergracile*) and *mia bong* (*Bambusa tulda*). The ribs of the plait are made of very thin bamboo strips ¼ to ½ inch wide while the actual plait is done with fine bamboo strands, 1/16 inch or less in diameter. The plaiting is usually done on a wooden mould cut to the shape of the utensil required; with large articles a mould is dispensed with. Women and young girls, who are very skilful and neat at the work, do a great deal of this bamboo plaiting; indeed considerable skill is essential in the case of round boxes where it is necessary to be very accurate otherwise the lids would not fit closely. When the plaiting is finished a rim, about ½ inch wide, of *rak* resin is painted round the edge of the plait, this keeps it from unravelling in the subsequent processes. After the rim of *rak* is dry the article is smeared, inside and outside, with a thick emulsion formed by the mixture of *rak* with water, the exess of the emulsion being taken off with a broad, short-bristled brush. The article is then laid aside to dry for two or three days. The main object of this treatment is to keep the plaiting firmly in place during the next process, the emulsion being less likely to crack and splinter under the knife than pure *rak* would be. When dry the article is shaved smooth with a sharp knife, any irregularities in the plating being removed by this process; if the article is round the shaving is done on a lathe. A mixture of *rak*, ash of paddi husk and very fine earth, well mixed and made into a thick paste, is now spread over the article with broad brush. This paste fills up all interstices in the plaiting.

The earth used must be very fine and quite free from grit or sand otherwise it is impossible to get a good surface on the finished article. After this application another drying is necessary and then the surface is smoothed down, on a lathe if possible, with a fine grained stone, the surface rubbed being kept constantly wet. The article now receives three coats of pure *rak*, being allowed to dry, in a cool shady place, between each coat. This process takes from 5 to 15 days according to the weather. In very hot weather, drying is difficult, it is usual than to dry the articles in underground pits; this is not necessary in the rains or cold season when drying can be done in a shed. As soon as the third coat of *rak* is dry the surface is smoothed down, this time with the rough leaves of a fig tree (*Ficus cunia*) known as *bai nawt* (Lao) or *bai lin sûa* (Siamese).

Before this last polishing the article, if a round one, is tested on a small lathe to see if it is truly round; if not it has to have further applications of the ash paste and revarnishings till it is so.

This seldom has to be done as, considering the rough methods used, the round boxes are wonderfully accurate both in their roundness and in the fitting of their lids.

The article is now ready for the engraver who cuts the pattern with a fine steel style, going through the outer coats of *rak* to the ash mixture beneath. The pattern followed is usually a conventional one of small flowers and leaves closely set over the whole surface. Occasionally other subjects are chosen, such as the animals representing the cycle of years, but even so the spaces between the animals are filled in the conventional design. Whatever may be the pattern chosen it is done without a copy of any kind. An ordinary betel-box can be engraved in less than a day but two to three days would be taken on the same sized box for finer work in which the flowers and leaves are smaller and more closely set. After this engraving there is left a pattern of grey lines on a black back-ground. Sometimes the article is left in this state but more usually it goes through further processes to produce red or gilt lines.

When the pattern is to be red, as is most frequently the case, the whole surface, after engraving, is painted over with

a mixture of red lead, *rak* and *mak mû* oil, an oil expressed from the seeds of the *mak mû* tree (*Parinarium albidum*). This is allowed to dry and then the surface is rubbed down with *nawt* leaves which take off all the red except that in the engraved lines. The final treatment is a coat of a varnish made by mixing pork fat and *rak*. When a pattern of gilt lines is desired a slightly different procedure is followed in the latter stages. After engraving a coat of *rak* is painted over the article and while this coat is still wet gold leaf is laid on and spread smoothly over the surface being pressed well down so as to enter the engraved lines, the article is then rubbed with a cloth which removes all the gold leaf except that in the lines.

A bolder design in gilt and black, often representing conventional lotus buds, is obtained by still another method. The article goes on to the third coat of *rak* as already described, but, instead then of engraving a pattern, the design is marked out with a yellow pigment in watery solution. The pigment is painted over those portions which are to be black in the finished product. When the pigment is dry gold leaf is spread evenly over the whole surface and a coat of *rak* given. After allowing this coat to dry the article is washed and gently rubbed till all the gold leaf over the pigment, together with the pigment itself, comes away, that over the unpigmented portion remaining.

The methods sketched above are those followed in obtaining the three chief types of Chiengmai lacquer, red lines on black, gilt lines on black and black and gilt in broad design.

It is not easy to arrive at any estimate of the number of people engaged in this business or to compute the amount of work turned out annually. While the actual lacquering is usually done in regular establishments, some of the work, such as plaiting and engraving, is taken away to the workman's, or workwoman's own house. The number of workers varies from day to day, each person working as he has the time or inclination to do so. During the seasons of planting and harvesting rice very little lacquer work is done. Considerations such as these make it difficult to say how many workers are engaged in the trade, they probably do not exceed five hundred.

The estimate of the number of lacquer articles made and their value is no easier as manufacturers keep no records of their sales. One of the largest manufacturers estimated that he turned out about 10,000 articles a year and that this was about a tenth of the total output of Chiengmai, which would give an annual output of 100,000 articles for the whole of Chiengmai.

Articles vary greatly in price according to their size and workmanship, small pieces can be bought for 20 or 30 satangs each while large pieces, or those of specially good workmanship, may run to as many ticals. It is probable that the average price of all articles, taking the large with the small, is approximately one tical, which, with the above estimate of annual output, would make the value of the lacquer ware annually made in Chiengmai somewhere about 100,000 ticals.

The above figures must be considered a very rough estimate indeed, they are only put forward as giving some indication of the importance of the lacquer trade in Chiengmai. At present the lacquer ware is used almost entirely within the country but the trade could readily expand if an outside demand arose as there is a plentiful supply of the raw materials.—[*The Record*, 1923.]

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THE AERO-PHOTO-SURVEY AND MAPPING OF THE FORESTS OF THE IRRAWADDY DELTA.

[NOTE.—The following is an advanee copy of the general report on the aero-photo-survey. Full reports by the various officers employed will shortly be issued in a special bulletin.]

PART I.—DESCRIPTION OF THE AREA.

Area included in the survey.—The forests over which the aero-photo-survey has been carried out are the reserved forests on the Delta Division, Burma. They are situated in the Myangmya and Pyapon Civil Districts and extend to just over 1,000 sq. miles. A rough estimate of their area is given below :—

Kyaukkon	...	...	...	2 sq. miles.
Lebyauk	...	...	...	41 " "
Kyagan-Kwinbauk	...	...	...	97 " "
Pyinalan	...	...	...	145 " "
Kakayan	...	...	...	100 " "
Labutkwe	...	...	...	21 " "
Kalayaik	...	...	...	31 " "
Nyinaung	...	...	...	25 " "
Kadonkani	...	...	...	213 " "
Meinmahla	...	...	...	49 " "
Pyindaye	...	...	...	306 " "
		Total	...	1,030 " "

About 350 sq. miles of waterways and unclassed forests were also included in the survey.

Configuration.—The area forms part of the Irrawaddy Delta. "Other than a low ridge in the Myaungmya District on which the Kyaukkon and Lebyauk reserves are situated and which rises to a height of not more than 120' above the average sea level, the whole area is essentially deltaic being formed by the alluvial deposits of the Irrawaddy. The plain so formed is intersected by large and small rivers and creeks and by cross channels dividing it up into numerous islands. As the level varies by only a few inches, except in the case of a few sandy ridges near the sea face which are 3 to 5 feet above the average and small areas further north, the whole country is submerged at spring tides during the rains and much of it also during neap tides at other seasons of the year. This variation in level combined with the degree of salinity of the water, which floods the forest, is the main factor in determining the kind of tree growth."*

Description of the Forests.—A full description of these forests is given in the working plan for the Delta Forest Division by Mr. A. W. Moodie, O.B.E. Briefly the forest may be classified into the following main types :—

1. Pure or almost pure forest of *kanazo (Heritiera minor)*. This covers large areas and is the most valuable class of forest in the Delta.

2. Mangrove forest containing various species of the natural order *Rhizophoraceæ*. These forests are usually confined to the mud banks along creeks.

3. Low scrub jungle commonly known as *byaik* which may be of three types—

(*i*) Characterised by the presence of *thinbaung (Phœnix paludosa)*.

(*ii*) Characterised by the presence of *myinga (Cynometra ramiflora)*.

(*iii*) Characterised by the absence of real tree growth and by the presence of tall grasses and creepers.

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*Extract from Working Plan for Delta Forest Division, by A. W. Moodie, Esq., B.E., 1924.

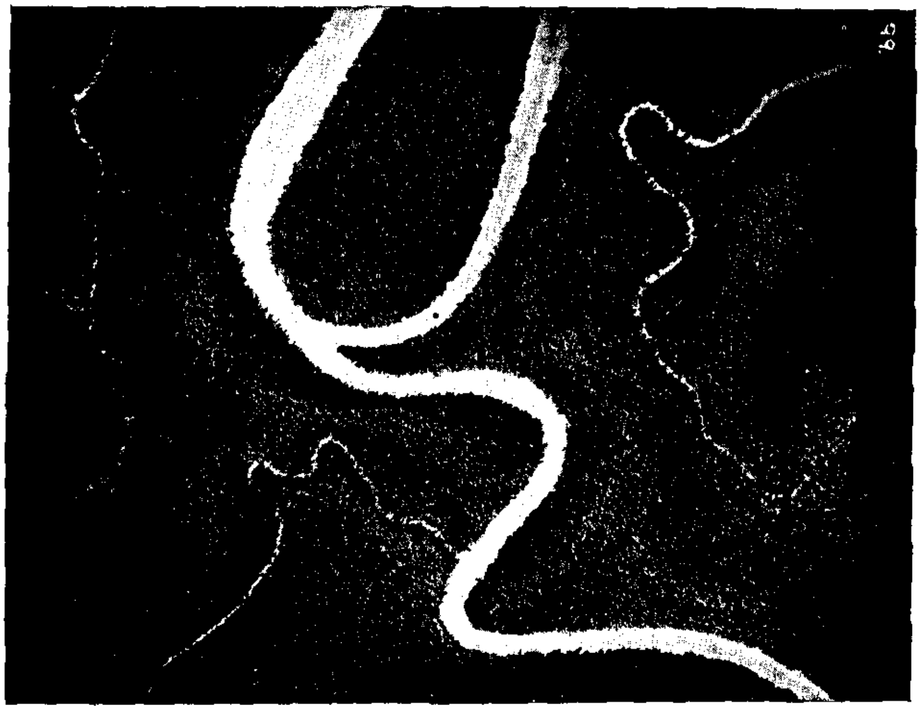

Fig. 1. Vertical view. The dark grey forest is *kanazo* (*Heritiera minor*), light grey is mainly *myinga* (*Cynometra ramiflora*). On the inner curve of the main stream is a *byuchidauk* mud-bank (*Rhizophora* sp).

Fig. 2. Oblique view. *Kanbala* (*Sonneratia apetala*) over young *kanazo* (*Heritiera minor*) in foreground. In the background dark forest is mature *kanazo*, grey is mainly *myinga* (*Cynometra ramiflora*).

IRRAWADDY AERO-PHOTO SURVEY.

4. *Kanbala* (*Sonneratia apetala* and *lamu* (*Sonneratia acida*) are characteristic of newly formed mud banks, the former mainly in salt water, where single trees survive to tower above the other growth when the level is gradually raised, and the latter mainly where the water is fresh.

5. Low forest characterised by an abundance of *madama* (*Ceriops Roxburghiana*). Similar to this is a low mixed forest characterised by *madama* and *thayaw* (*Excœcaria Agallocha*).

6. Higher level forest where the growth approaches more nearly to the ordinary low level evergreen type and contains such species as *kanyin* (*Dipterocarpus alatus*) and *sinnin thayet* (*Mangifera caloneura*).

7. Grassy blanks.

Previous surveys.—Until quite recently the only map available was Fitzroy's reconnaissance map on a scale of 4 miles to the inch dating from 1864, which although very good of its type was not sufficiently accurate for the work required. Starting from 1918-19 the Pyindaye Reserve was surveyed on a scale of 4 inches to a mile by a special party under the orders of the Commissioner of Settlements and Land Records. The costs of this survey was paid by the Forest Department in 1922-23 and amounted to Rs. 26,626 or Rs. 87 per sq. mile for the 305 sq miles of this reserve. The survey has since been proved to be very inaccurate. Only the main rivers were accurately surveyed and the artificial boundaries of the reserve, even where properly demarcated, have not been correctly shown.

In 1921 Mr. A. W. Moodie, O.B.E., was posted to the Delta Division and promptly commenced a survey of the reserves by cutting linear survey lines at intervals of one mile usually from east to west and from north to south. The lines were made with the aid of prismatic compasses and were measured with a chain, all natural features such as streams and all changes of forest type being noted. This work was commenced before the aerial survey had been proposed and the results have allowed of the first working plan ever made for these forests to be drawn up. This survey only cost Rs, 15 per sq. mile and though it

cannot compare in accuracy with the aerial survey it was a notable effort and gave valuable information about the reserves.

Difficulties of ground surveys.—To anyone who has visited deltaic forest the difficulties of an accurate ground survey are obvious. Wide waterways with a rapid current ebbing and flowing with the tide; mud banks in which at every step the surveyor sinks to the knees or even further; at high tide large tracts under water too deep to walk in; small creeks only navigable at high tide in small boats and then on the so-called land even at low tide a mass of aerial roots, which make walking slow and painful and a dense tangled undergrowth through which every step has to be cut; all this tends to make ground survey on an accurate scale slow and extremely expensive. It is estimated that survey on a scale of 4 inches to 1 mile would have cost fully Rs. 500 per sq mile and would have taken 3 or 4 years.

Suitability of the country for aerial survey.—On the other hand the country must be considered specially suited for aerial survey. In the first place it is level and therefore there was no difficulty with heights or contours. In the second place the profusion of large rivers allowed for safe landing places within easy distance of any part of the area. In the third place all small creeks that were not entirely overhung by trees would be visible from the air and these form practically the only natural features required to map. Finally the forest contained several most distinctive types, chief of which, the *kanazo* forest was almost pure and, from ground level at least, of a most distinctive appearance and it was believed that useful data of the distribution of the different types of forest would be given by aero-photography.

II.—PRELIMINARY NEGOTIATIONS.

Origin of the idea of aerial survey.—The idea of an aerial survey appears to have originated with Mr. E. F. A. Hay, I.F.S., who was posted on special duty to these reserves with the object of preparing stock-maps and colonising those parts of the reserves where the stock was poor and the area more suitable

for paddy cultivation than forest. The idea appears to have, received but little consideration until these reserves were inspected by Mr. H. W. A. Watson in April 1920 when he was Conservator of the Delta Circle. Mr. Watson made the following note in his inspection report:—

"The question of aerial survey suggested by Mr. E. A. Hay in his report was not seriously considered. *Nevertheless I would venture to urge that this question of aerial survey be seriously considered.*. Owing to the dense forest growth, the diversity and number of the creeks and the absence of fresh water a survey on the ordinary lines, which would have to be supplemented by a stock-map also on the ordinary lines, will be a cumbrous and expensive process.

Whereas conditions for aerial work are ideal; not only so but an aerial survey would at once show up the *kanaso* stocking which is abrupt and easily distinguishable in appearance and colouration from the other growth and thereby save the further cumbrous elaboration by the usual means of a stock-map.

The saving in time should also be a consideration. The ordinary method will take years, the aerial method weeks."

The chief credit not only for the original idea of the aerial survey but also for the enquiry and negotiation leading up to the operation must be given to Mr. Watson. In spite of discouragement and difficulties he has persisted with the project, the success of which fully justifies his most sanguine expectation.

Mr. Watson went to Engand on leave later in 1922 and while there made several enquiries into the possibility of aerial survey and useful information was obtained from the Air Ministry, the War Office and several private individuals. In this connection mention must be made of much assistance and advice given on several occasions by Mr. Ellwood Wilson, formerly of the Laurentide Timber Co. of Quebec and now Managing Director of the Fairchild Aerial Surveys Company, Limited, of Grand Mere, Quebec. The success of aerial photography in the work of stock-mapping and surveying of their forests by the Laurentide Timber Co. formed the basis on which the success of similar operations in the Irrawaddy Delta could be determined.

Progress of negotiations.—On Mr. Watson's return to Burma late in 1920 the matter was taken up vigorously and early in 1921 it was discussed with Col. Ryder and Col. Coldstream, Surveyor-General and Superintendent, Eastern Circle, Survey of India, respectively. At that time the most recent experience of aerial survey in India had been incorporated in a paper by Major Lewis and Captain Salmond on experiments in airplane photo surveying. From these experiments it appeared that there was very considerable difficulty in flying straight enough to obtain a regular series of strips covering a given piece of country and Col. Ryder considered that it would be better to go slow and obtain further experience before air survey in the Delta could be taken up.

Correspondence during 1921 with one or two firms which had been formed for air transport and air survey led to nothing.

In January 1922, Mr. Kemp, then Chief Inspector of Aircraft, India, came over to Burma to investigate aviation possibilities. Mr. Watson took this opportunity of discussing the aerial survey of the Delta forests with him during his visit and, as a result, in the following August, a conference on the subject met to discuss the matter in Maymyo. At this conference the Chief Conservator of Forests, Mr. Smales, the Surveyor-General for India, Col. Ryder, the Superintendent, Eastern Circle, Survey of India, Col. Coldstream, Mr. Kemp and Mr. Watson were present. It was generally agreed that the project was perfectly feasible and Mr. Kemp was asked to prepare detailed estimates for the work for 1,000 sq. miles. These estimates were sent in November 1922, a copy being sent both to the Local Government and to the Surveyor-General. The Surveyor-General promptly promised the co-operation of his department and undertook—

(1) The fixing of the necessary points and

(2) The fair drawing of sheets for publication.

He also stated that he did not propose to make any charge to the Burma Government for these services as they would be useful for the ordinary 1-inch topographical survey which was an Imperial charge. He strongly recommended the acceptance of Mr. Kemp's estimate. From this time on the arrangements for the

air survey were in the hands of Col. Gunter, Superintendent, Burma Circle, Survey of India, who had had considerable previous experience of aero-survery. After some further negotiations, the estimate was recast more especially in view of the fact that the Survey of India had undertaken all the work in connection with the fixing of points and the preparation of the final map. It then remained to obtain the approval of the Local Government to the work and the provision of funds for the year 1923-24. The most important matter was to persuade the Finance Committee that the operation was desirable and advisable and this was not done without some difficulty. A meeting in May 1923 decided to postpone a further consideration until a later meeting. At this later meeting the case in favour of the survey was most ably put by Col. Gunter, Superintendent, Burma Circle, Survey of India, and it was mainly owing to his efforts that the Finance Committee passed the project readily. In the meantime Mr. Kemp had left the service of Government owing to the termination of his appointment and he was therefore a private individual with a free hand to carry out the work. A contract was drawn up between the Government of Burma and Mr. Kemp of which the main details are given in the following section :—

Details of the contract drawn up with Mr. Kemp.—Briefly the conditions of the contract were that for a payment of Rs. 2,75,000 for the first 1,000 square miles and for Rs. 28,000 for a further 350 sq. miles to be added later, if considered necessary the contractor (Mr. Kemp) undertook to carry out the following work :—

The production of vertical and oblique photographs suitable and necessary for the compilation of a 4 inch = 1 mile scale map of the area—(*N.B.*—The scale was later altered to 3 inch = 1 mile as this was found more convenient for mapping from the photographs.)

The following conditions were imposed :—

1. The Survey of India were to be responsible for the fixing of the trigonometrical points necessary to control the mosaic, the compilation of the mosaics and resultant maps.

2. Vertical and oblique photos were to be submitted to the Survey of India to enable them to compile a forest map and to the Forest Department to enable them to compile a stock-map.

3. All land areas to be covered by vertical photos including water channels of such width that both banks could be included in one photo.

4. Negatives to be $7'' \times 7''$ or $5'' \times 4''$. (The latter alternative was taken.)

5. Overlaps both forward and lateral to be 30 per cent. and in any case not less than 20 per cent.

6. Departure from mean height at which photos to be taken not to exceed 1 per cent.

7. Photos to be free from tilt. Tilt in no case to exceed 3°.

8. The quality of the photographs to be such that no difficulty should be experienced in picking out all details necessary for the map.

9. Photography to be carried out at about the same time each day to be decided after experiment. Narrow channels not to be entirely obscured by cast shadows of the trees alongside.

10. Vertical photos on a scale, larger or smaller than the normal, to be taken to elucidate difficulties met with in the compilation of the rectified mosaic.

11. Negatives to become the property of the Government of Burma.

12. Two prints of every vertical photo taken as well as one print of all oblique photos and two extra prints of such photos as may be required to be supplied to the Survey of India.

Two prints of all photos required by the Forest Department and a rough mosaic to be supplied to the Forest Department.

III.—CARRYING OUT OF THE SURVEY.

NOTE.—Full reports on the work carried out and results from each point of view have been drawn up by Mr. Kemp and the special officers employed on the work and will shortly be issued in a bulletin. Only a rough summary will be given here.

Ground control.—This was carried out during November, December 1923 and January 1924 by No. 18 Party (Aero-photo) of the Survey of India under the able control of Major C. G.

Lewis, R.E., and consisted in the triangulation of fixed points. which would be recognisable on the photographs.

Aerial photography.—A base for the aeroplanes was formed in Rangoon at Monkey Point some 90 miles by air line from the centre of the area to be surveyed. A movable emergency and advance base was formed by a launch with a motor boat and *sampans* attached. The type of seaplane used was a D. H. 9 Puma engined service type aeroplane converted to a seaplane by the fitting of floats especially designed by Mr. Kemp. Full details of the seaplanes and of the photographic apparatus used is given in Mr. Kemp's report. Flying Officer, Mr. J. Durward was lent on leave without pay by the kind permission of the A. O. C., Royal Air Force (India), for employment as photographer and Major C. K. Cochran-Patrick, D.S.O., M.C., late of the R. A. F., was retained as pilot.

Photography was commenced in February 1924 and completed early in April 1924. The start was delayed owing to delays in the settlement of the contract. January and February would have been the best months to have carried out the work as weather and visibility are both better at that time.

Examination of the forests with a view to determining how the different types of forest could be determined from the photographs.—Mr. C. W. Scott, D.F.C., and C. R. Robbins, D.F.C., M.C., of the Forest Department, both of whom had served in the R. A. F. during the war, were deputed for short periods to examine the photos and compare them with the actual types of forest on the ground. Both of these officers made trial flights over the area and visited parts of the forest.

Mapping from the photographs.—As soon as the prints were available the preparation of rectified mosaics and the compilation of the maps were undertaken by No. 18 Party (Aero-photo) Survey of India under Major Lewis in Maymyo. At the time of writing (August 1924) considerable progress has been made and it is hoped to complete the maps by November 1924.

Scale of maps.—At first it was arranged that the maps should be compiled on a scale of 4 inches = 1 mile. The actual scale of the photos proved to be about 3·4 inches = 1 mile and it was

agreed to alter the final scale to 3 inches = 1 mile as it was considered that this scale was sufficient for all purposes and was easier to work up the rectified mosaics, from which the final map would be compiled, to this scale.

Stock-mapping.—The final stock-mapping of the whole area must await the completion of the maps. The lines on which the stock-mapping can be carried out have already been determined and will be fully described in the reports written by Messrs. Scott and Robbins which will be published in a special bulletin. From their reports it is clear that no less than eight to ten different types of forest can be distinguished on the photographs and it is even possible to distinguish between fully stocked *kanazo* forest and the same forest that has been heavily worked. It is probable that a further comparison of the photos with the actual forests will indicate to a certain extent the quality of the growth of the *kanazo* forest.

Summary of results.—Although the results of the aerial survey from each point of view will be given in the special bulletin shortly to be issued, a short summary from the Forest Department point of view is given here—

1. *Cost.*—The cost including ground work and mapping has worked out at about Rs. 293·7 per sq. mile. A ground survey would have cost in the neighbourhood of Rs. 500 per sq. mile.

2. *Rapidity.*—The actual survey was completed in 5 months and the whole period taken from the commencement of the fixing of the ground control to the completion of maps and stock-maps should not greatly exceed one year. Ground survey would have taken 3 to 4 years.

3. *Accuracy.*—This is far in excess of anything that could have been obtained by ground survey in this type of country except at a further increase in cost and time.

4. *Details available.*—The areas and distribution of the different types of forests are not only obtainable at no increase of cost but with an accuracy that it would have taken years and a considerable expenditure to have equalled.

At the same time it must be remembered that this operation has been carried out over a country and type of forest that cannot be compared with the usual country and type of forest over the greater part of Burma and India. In the first place, the country is absolutely level. No trouble was therefore experienced with regard to hills and contours. In the second place the forest is of a special type and the more valuable type is characterised by a predominance of one species of most distinctive colouration and appearance.

It can by no means be proved from the success of this operation that aerial survey and exploration can be applied to hilly country or to different types of forest with equal success. Unfortunately it was not found possible owing to the delayed start to carry out a thorough series of experimental flights over different types of forest on the hills, and the single flight over the Pegu Yomas in Insein Division was vitiated by the time of year (April) when not only was visibility poor but the trees and bamboos with few exceptions were leafless and in such a state did not show any of their usual characters. (A description of this flight with conclusions is given in Mr. Scott's note.) Proposals have been placed before the Local Government to allow of a further season's work being carried out in the unexplored forests of South Tenasserim Division which cover over 14,000 sq. miles and are urgently in need of examination. These proposals have been accepted and will allow of a thorough trial of air exploration and photography in different types of forest on hilly country which will be of the greatest interest and benefit in making a full trial of the use of aeroplanes in forest mapping and exploration.

Utility of aerial survey of cultivated areas.—In conclusion here is one point that has been brought out very strongly in the course of this aerial survey and that is the extraordinary clearness of field boundaries on cultivated land. During the course of the work several photographs were taken of areas under cultivation. In rice cultivation every field is surrounded by a *kazin* or earth bund to hold up the water level. These bunds show up most

distinctly and as they form the boundaries between different fields and ownerships the utility of a survey of cultivated land can be *amply proved*.

H. R. BLANFORD, I.F.S.

THE CULTIVATION OF CONIFERS IN NORTHERN INDIA.

There appears to be very little on record regarding the successes and failures with cultivated plants in India with the result that the same species are tried over and over again. In the case of plants belonging to the Coniferæ, which often grow well without flowering, at any rate for very many years, identification becomes difficult so that in gardens such as the Botanic Gardens, Calcutta and Saharanpur, and the Agri-Horticultural Gardens, Lahore, there are conifers of which the genus only is known. There is usually no record as to the origin of the seed from which the plants were grown and the names if they have one at all often appear to have been invented by one of the *malis*.

Continuity appears to be extremely difficult to ensure in India, labels very soon become illegible or mixed or stolen so that in a few years a collection of conifers becomes a mass of unnamed plants and one has to wait till they flower in order to be able to identify them.

During the last few years efforts have been made to get together a representative collection of conifers for the Arboretum at the New Forest Research Institute and although there are no plants more than 3 years old a good many results have emerged, and if claims to success cannot be made with much confidence in many cases, the failures have often been quite definite.

Conifers in cultivation vary very greatly, some grow quite well in a climate altogether different to that of their homes whereas others appear to be much more particular. These differences seem to be more or less generic so that from the behaviour of one or two members of a genus one can get a fairly good idea as to what the rest will do.

Podocarpus.—Pilger in Das Pflanzenreich admits 55 species, some have since been described so that there are over 60 species in the genus. I believe that at least half of these and perhap all could be grown in Dehra Dun. Hitherto only two species are at all commonly cultivated in India and a third *P. neriifolius* D. Don is listed for the Botanic Gardens, Calcutta. *Podocarpus macrophyllus*, D. Don, subsp., *maki* usually known in India as *P. chinensis*, Wall., was probably introduced in 1811 from China to the Botanic Gardens, Calcutta, where it has been cultivated ever since. This species is a native of Japan and grows well in Calcutta, Saharanpur and Lahore. In Upper India only the male plant is in cultivation. It is propagated by cuttings which root fairly readily with *Podocarpus. Podocarpus elongatus* was introduced from the Cape in 1799 to the Botanic Gardens, Calcutta, where it was growing in 1842 but had apparently never flowered, It does not appear to exist in Calcutta now. There is a specimen in Dehra Dun of what appears to be this species though as far as I know it has never flowered. It is a healthy straight tree 32 feet high by 2 ft. 2 in. girth. This tree is probably about 35 years old as in the Dehra Dun herbarium there is a sheet showing the leaves only collected by Mr. Gamble in 1893 with the note "Podocarpus introduced from the Cape." The tree was doubtless planted by Mr. Gamble. This species is also grown in other gardens in Dehra Dun as well as in Saharanpur and it is propagated by cuttings. I have kept the name *P. elongatus* as it is fairly certain that this species is the one usually called by this name in S. Africa where all the Podocarps have for years been known by names that it is now believed do not belong to them and great confusion has been caused by recent attempts to alter the nomenclature. Similarly with seed recently received from S. Africa I have kept the names supplied with the seed and shown in brackets the latest names proposed.

We now have seedlings of the following species growing well in Dehra Dun:—

Podocarpus elongatus.—Seed supplied by the S. African Forest Department. (Probably *P. falcatus*, R. Br.)

Podocarpus falcatus.—Seed from S. African Forest Department. (Probably *P. Henkelii*, Staf.)

Podocarpus gracilor Pilger. Seed from the Forest Department, British East Africa.

Podocarpus pedunculatus Bailey. Seed from the Botanic Gardens, Brisbane = *P. amarus*, Blume fide Pilger.

Podocarpus thunbergii.—Seed from the S. African Forest Department. (Probably *P. latifolius*, R. Br.)

Seed of the Podocarps germinates very freely if the seed is fresh but it does not keep well so that several other species we have tried have failed to germinate. The young seedlings are vigorous and do not suffer in any way from the constant rain during the monsoon.

Araucaria.—Seward and Miss Ford in Phil. Trans. Royal Soc., Lond., Vol. 198 (1906), p. 317 et seq., enumerate 11 species; Dallimore and Jackson, Handbook of the Coniferæ, omit two of these but add one making 10 species. The members of this genus appear to be very particular in their requirements. One species *A. imbricata*, Pav., is temperate and is probably quite unsuitable for low elevations. The only specimen I know in India is at Annandale, Simla, 6,000 ft. It is not growing particularly well and probably requires a more uniformly moist climate. All the rest might be expected to do well in Dehra Dun. Four species *A. Bidwillii*, Hook., *A. Cookii*, R. Br., *A. Cunninghamii*, Sweet, and *A. exelsa*, R. Br., are listed as growing in the Botanic Gardens, Calcutta, in 1913 and the two latter in 1842. Of these only *A. Cunninghamii* does well. *A. Bidwillii*, Hook., is growing well in Dehra Dun and ripens its seeds in some years. The seeds are much appreciated by squirrels or they would doubtless germinate under the trees. Germination is very peculiar, the food material from the cotyledons is withdrawn into a woody carrot-like structure produced some inches below the surface of the ground. The "woody carrot" so formed may remain dormant till the following spring or it may produce a leafy shoot without much delay. Young seedlings are sensitive to drought in Dehra Dun and require watering in the dry season. *A. Bidwillii* does not stand heat very well, a plant in Lahore died in a

hot spell after growing a few years but there is a fair specimen in Amritsar and also one in Simla at 7,000 ft.

A. braziliana, Rich., I have tried this species twice. The first batch of seedlings grew extremely well up to the rains when they gradually damped off. The second lot of seed was sown towards the end of the rains and most of the seedlings damped off at once. The germination is similar to that of *A. Bidwillii* and a few seedlings were delayed and did not appear above ground till the monsoon was almost over. These seedlings failed to survive the following monsoon.

A. Cunninghamii, Aiton. This species is the best of the genus for Northern India and is grown in Lucknow and Saharanpur and does fairly well in Lahore. In Dehra Dun it produces cones freely but very little of the seed appears to be fertile. I have so far failed to get any germination from local seed but have observed a natural seedling under the largest trees in Dehra

Araucarias should be grown from fresh seeds, if kept the seed soon loses vitality. They can also be rooted from cuttings but terminal shoots are necessary, taken from double or multiple leaders.

Callitris.—Baker and Smith—A research on the Pines of Australia admit 18 species in the genus. Maiden, For. Fl. N. S. W. II (1907), p. 30 *et seq.*, only admits 13 species. As far as I am aware no attempts have been made to grow the Australian Cypresses in Northern India previous to 1912 when several species were tried in Lahore and Saharanpur. In Lahore they proved unable to stand combined heat and damp and none ever survived the seedling stage. Plants taken to Lahore from Saharanpur soon became sickly and died. In Saharanpur results were better and there is or used to be a good specimen of *Callitris glauca*, R., Br., in the Botanic Gardens. In Dehra Dun there are at lest four specimens of *Callitris glauca*, R. Br., which are now about 14 years old and make very ornamental trees. They have just started to produce cones.

In our recent trials seed of several species from South Africa were tried and also four species from Australia of which only one *C. robusta* germinated. In all cases the seedlings suffered much from damp during the monsoon and many small plants planted

out died and had to be replaced. Seed of *Callitris tasmanica*, Baker and Smith from the Nilgiris has given perhaps better results but these seedlings also suffered much during the rains and as the seed was received quite fresh and in the cones it germinated very freely so that it is doubtful if the percentage of success is any better. As the species of *Callitris* was in many cases not known for certain and as only some 8 or 10 plants have reached the planting stage they were planted together without preserving the names in most cases so that until they fruit it will not be possible to say what species we have.

Callitris tasmanica has passed successfully through two monsoons and is growing well.

According to Nicholson, Dictionary of Gardening, *Callitris* may be grown from cuttings as however the only species he specifically mentions is not now considered to belong to this genus, it is not known whether the Australian Cypresses root sufficiently readily from cuttings to make this method of propagation of practical value for raising plants for ornamental purposes. Seed germinates very readily if fresh but does not seem to retain its vitality for long. Plants of this genus should be tried in the lower hill stations for ornamental planting as the seedlings would probably stand the damp of the rains better in a cooler climate than they do in the plains.

Tetraclinis.—A genus containing a single species, *T. articulata*, Masters more commonly known as *Callitris quadrivalvis*, Vent. The only specimen I know in Northern India is one in Lahore. It is growing very well and makes an ornamental cypress-like tree. Fresh seeds from this tree germinate freely but they are very susceptible to damp and consequently the tree is likely to remain rare in cultivation in the plains. It is indigenous to N.-W. Africa and would probably do well in the hills at moderate elevations. So far attempts to grow it in Dehra Dun have failed as the seed has never germinated. As with the Australian Cypresses the seeds do not appear to retain vitality if kept.

Widdringtonia.—A genus containing 5 species of shrubs and trees found on the mountains of S. Africa as far north

as Nyassaland. I do not think any are in cultivation in Northern India nor are they likely to do well but with conifers it is unsafe to assume anything without a trial. The largest species is *W. Whytei,* Rendle, from Nyassaland. Seed of this species germinated very well in Dehra Dun but the young plants suffered greatly during the rains. A considerable number have survived the monsoon though in a miserable condition. They do not look at all promising but it is always possible that when beyond the seedling stage they will stand the monsoon better. According to Voigt. Hort. Suburb, Calc, both *Widdringtonia cupressoides* Endl., and *W. juniperoides,* Endl., were in cultivation in Calcutta in 1842, the latter having grown for over 12 years without flowering. All the South African species would be worth a further trial.

(*To be continued.*)

R. N. PARKER, I.F.S.

RECENT DEVELOPMENTS IN THE PUNJAB IRRIGATED PLANTATIONS.

Since the post-war slump in the timber trade which has checked the development of our Himalayan forests, it has become more obvious that the irrigated plantations are one of the Punjab's best forest investments. In addition to those already being formed, of which the eventual area will be about 50,000 acres, the Punjab Government has agreed to provide a further 30,000 acres in the new Sutlej Valley canals area, and the Bombay foresters are manœuvring for ground in the Sukkar zone in Sind. As it is some years since a resume of this work appeared in your columns from the pen of Mr. R. N. Parker, it may be of interest to foresters throughout India to hear of the more recent developments.

Of the plantations now being formed, Daphar on the Upper Jhelum Canal is undoubtedly the most promising. Practically 2,000 out of the total of 7,000 acres are now afforested, and at the rate of about 350 acres per annum, will be finished in 1937. The balance of the unplanted land, as in Chichawatni and

Khanewal on the Lower Bari Doab Canal, is leased out for cotton cultivation, and the revenue thus obtained more than covers the cost of formation of the plantation.

One of our most promising plantations, Kotlakhpat, which had an area of 2,000 acres only 7 miles from Lahore, was unfortunately surrendered in 1922 to a Model Town Building Society for an old song. The Forest Department was paid some meagre compensation for the value of standing crops of 5 years of age and over, and the area has since been cut up in a wonderful maze of circular roads. So far, about 4 lakhs of rupees have been subscribed by the optimistic owners of land plots, but up to the present little has been seen of any buildings except the old forest bungalow, which is now to be a Gentlemen's Club. There is also to be a Leper Hospital and a Sewage Farm so no doubt the town will be a model one if it is ever finished.

But to return to forestry, it is interesting to see that the stoppage of watering during the last two years in Kotlakhpat has not affected the forest badly, for the water level is high (about 17 feet down) and most of the trees have succeeded in getting their roots down to it. On the other hand, the other plantations cannot be treated in this way with impunity. In Changa Manga the dry summers of 1920 and 1921 have taken a heavy toll of the forest. In those years the rainfall was 3·28 and 8·46 inches respectively, compared with an average of 13·98. The Ravi River failed, the canal supply suffered, and during those two years Changa Manga got 75 per cent. and 30 per cent. of the minimum defined in the canal agreement. Many compartments went unwatered for one year, some for two, and the result was that many areas died off. A recent stock survey showed that about 30 lakhs of cubic feet of wood was killed and much of this we have not yet been able to remove. The forest is littered with dead patches, the regeneration of which we cannot undertake until they come within the W. P. prescriptions of fellings, and meanwhile they are absolutely unproductive.

Similar shortages of water in the Punjab rivers and particularly in the Ravi, have occurred at frequent intervals, generally every 4th or 5th year, and we have no guarantees against future

shortages. Changa Manga, unlike the younger plantations, was started originally to use the surplus water on the "tail" of the Upper Bari Doab. The zamindari demands are now very much in excess of the average supply, and in dry years the plantation is the first to suffer as there is little or no surplus water to be had. It seems a very short-sighted policy, therefore, to have embarked on the addition of another 2,000 acres to the irrigated plantation. This Shahpurjand Extension was begun in 1921 when the land in question had previously been brought under cultivation to meet the war-time demand for extra food grains. It was leased out in 1922 on a 5 years' contract, on which the contractor hands back some 300 acres each year ready for *shisham* sowing, pays a merely nominal land revenue, and is paid for all the work he does such as root stubbing, and the digging of channels and trenches for afforestation.

The planting up of Shahpurjand had often been discussed previously, but it was always shelved owing to lack of water. In spite of a fresh agreement with the Canal Department in 1920 for a larger supply, this has not materialised, as the figures for total acreage watered during the last decade will show:—

1914-15...	... 10,664	1919-20...	... 9,506
1915-16...	... 10,767	1920-21...	... 4,637
1916-17...	... 13,075	1921-22...	... 7,060
1917-18...	... 12,823	1922-23...	... 9,658
1918-19...	... 8,893	1923 24...	... 10,472

Another interesting point in the canal agreement is the farcial method by which our Changa Manga water supply is measured. In theory we should get a depth of 2·5 feet of water on the irrigable area, *i.e.* 1,248 million cubic feet. The Canal Department does not deal in cubic feet but in "cusecs," cubic feet per second, so our supply is measured once daily by the canal gauger; the daily readings are multiplied by 24 × 60 × 60 to give a reading of cubic feet of water on the assumption that the water actually runs for 24 hours. In practice the forest channels are a useful "dump" for spare water and are opened at times to adjust the level in the main canal, generally in the early morning. The

gauge reading taken at 8 A.M., however, is accepted for the 24 hours and the error is multiplied by 86,400! Thus we find that with a season's total of 21,000 cusecs—1½ times our minimum estimate—in 1923-24 we have been able to irrigate the whole plantation once only.

In Daphar also the watering arrangements leave a great deal to be desired. When the plantation was started in 1919 the Canal Department promised to remodel the distributory from which Daphar gets its supply. We have now reached the end of 1924 and nothing has yet been done. The minimum supply per acre of forest is considerably larger than that for zamindari cultivation, and as each year the forest increases in size the difficulties of carrying on with the present supply become more marked. Fortunately the permanent water level here is fairly high, as it has risen from 50 to 28 feet since the Upper Jhelum Canal was opened and some of the older crops have benefited by this. The rainfall here is extraordinarily erratic, for instance this year Daphar got practically no rain whatever until the 1st September, when it got 12 inches in two days!

What is probably the worst ground which has yet been afforested in the irrigated plantations has been successfully stocked this year in Daphar. A slope of 1 in 40 with a sterile soil of coarse sand and "kankar" limestone nodules has been planted with "root and shoot cuttings" of *shisham*, and the water has been detained in the trenches by treating the slope as a series of terraces, with two or three short lengths of trench in each the water being drained as slowly as possible from higher to lower terraces. There are also some very bad "*chappars*"—the buffalo-wallow swamps of pre-irrigation days—which remain flooded for part of the year and dry out as hard as brick. These can only be stocked by ridging the ground to considerably above the normal drainage level. *Shisham*, however, is not happy in such places, and we are still looking for a more suitable species with some commercial future.

The future of *Eucalyptus* is still problematical as we have not yet found a method of growing it on a commercial scale without the prohibitive expenses of intensive nursery work and

fencing of the forest area. Recent experiments have shown that quicker results with *Eucalyptus* can be had by making "root and shoot cuttings" of some of the species, and by this means we may be able to establish a considerable area of *Eucalyptus* in the younger plantations. It is a much less hardy subject than *shisham*, which responds amazingly to the root and shoot pruning of transplants, and has thus made possible the stocking of many areas where sowings had failed in the past. Cuttings were first used in Chichawatni four years ago, and their success has in a way revolutionised the plantation work. They require considerably less water in their first year than do sowings, and the regeneration work can be done from February to September where as sowings can only be made successfully in March to May.

There should also be a great future for bamboo in these plantations as the demand for them in the canal colonies is a large and ever-increasing one. An experimental plot of 2½ acres of bamboo transplants from seed established this year in Daphar will be watched with interest.

In these days when economy is everyone's warcry—or spook! the various attempts to reduce the heavy cost of establishing these plantations are interesting. The usual method, doubtless known to many of your readers, is to trench the area by hand labour, the trenches being ten feet apart and a foot square in cross-section, running along the contours, the water being brought from the main channel by a series of smaller channels running down the contour at intervals in each compartment. The cost of this work of trenching is Rs. 18 per acre; sowing Seed along the "berm" of the trench is Rs. 2 per acre and planting pruned cuttings 5 feet apart in the trenches is Rs. 4 per acre. Sowings as a rule, require a further Rs. 2 for weeding, but cuttings can generally get through without assistance The obvious line of attack is to reduce the cost of trenching, and two separate methods have been evolved during the last year at Daphar. One is the introduction of ploughing to cut the trenches, and the other is the adoption of the cultivator's method of raising crops in small "*khets*" of levelled ground separated by ridges to hold the water

Both of these have become possible only since the ground was leased for cultivation, for the previous *rakh* jungle land was too irregular in level and too full of tree roots to permit of such innovations.

An experimental area of 7 acres was treated in July 1924 with ploughing, an ordinary heavy metal plough (Chittanooga type) being worked backwards and forwards in the same furrow both ways, thus cutting a trench with slightly sloping sides 10" broad at the bottom and 8" to 10" deep. This of course is slightly rougher than the trench cut by hand labour, and has to be cleared of debris by a man following the plough. Half of the area was sown and half planted with cuttings, and both methods compare very favourably with the *shisham* in the surrounding areas of hand-made trenches which were afforested at the same time. The slightly rougher ploughed trench however is really more suitable for planting than for sowing. This ploughing was done with ploughs borrowed from a neighbouring Grass Farm, and the cost of the ploughmen's wages, bullocks' feed, etc., worked out at Rs. 5 per acre with sowings and Rs. 7 with planting. The initial outlay for purchasing the necessary ploughs and extra bullocks would be very small considering the saving involved.

A compartment of 44 acres was stocked in March 1924 by making "*killabandi khets*" of ¼ acre each, the water being brought down channels 2' × 1' between each second row of *khets*. Cuttings were transplanted at 5 foot intervals in rows 10 feet apart, and the result after a full season's growth is really excellent, the average height being 3½ feet and the success quite 98 %, while the neighbouring sowings which started out at the same time are still struggling under a heavy growth of grass and weeds. The cost of Rs. 3 per acre for making the channels and *bandhs* can be cut out in future by getting the cultivation lessee to make his *bandhs* according to our requirements for his cotton crops, so that the only expense will be Rs. 4 for planting the cuttings. This is probably the nearest approach to the "*taungya*" system which we can get in the irrigated plantations, and it can only be employed where the soil is good and the ground absolutely level. Weeding here has been quite unnecessary

as controlled grazing is possible after the plants have sprouted strongly. The actual amount of water required to establish this compartment was just 60% of that required for sowings on similar ground with hand-cut trenches.

The future development of the plantation work should therefore be along the lines of this *killabandi* work for all good level ground, and of ploughed trenches on poorer irregular areas.

In Tera, a small plantation started near Lahore in 1918, the trenches were originally dug 15 feet apart, as it was thought that the poor supply of water could be better conserved with trenches widely spaced. This has proved a doubtful innovation, for the rows of *shisham* have taken so long to form a canopy that the growth is poor, and the growth of "*kana*" grass, always a menace in these young plantations, has been particularly troublesome.

The sylvicultural system in Changa Manga is clearfelling on a 20-year rotation, leaving *shisham* standards for timber production where suitable trees have been saved from the ravages of the *shisham* fungus and the crowding out by mulberry. The regeneration of felled areas is generally complete from the growth of coppice shoots, rootsuckers, and natural seedlings, provided the area is retrenched and watered two or three times early in the next irrigation season. In the areas now being worked over, however, the old crop has been very badly affected by the drought of 1920-21 and the reproduction from coppice shoots and rootsuckers is rather poor.

Some years ago retrenching was discontinued for several seasons and, as a rule, the regeneration obtained by merely flooding the felled area was fairly good. In the drought-affected areas, however, retrenching is absolutely necessary, and in others it is advisable in economising the water supply. Where retrenching cannot be done owing to the expense, the watering could be more efficiently done by making a series of "*bandhs*" and dividing the area into acre or ¼-acre plots. The cost of reopening the old trenches is Rs 12 per acre—a heavy capital charge on each new crop—but there is little likelihood of reducing this unless by employing some elaborate tractor plough which could ride over the numerous roots without cannoning into them. The

American "Bennett Ditcher" is advertised as being capable of doing this, and would be well worth a trial.

The question of the actual profit to be made from irrigated plantations is an important one, for local governments are naturally more amenable to arguments in favour of the economic value of plantations in the canal colonies when they see that they yield a handsome profit in revenue. The figures for the last decade in Changa Manga are as follows:—

	Revenue.	Expenditure.	Surplus.
	Rs.	Rs.	Rs.
1913-14	2,20,318	69,442	1,50,876
1914-15	2,18,551	75,473	1,43,098
1915-16	2,04,439	90,908	1,13,531
1916-17	2,18,971	88,446	1,30,525
1917-18	2,66,129	88,709	1,77,420
1918-19	3,55,679	80,201	2,75,478
1919-20	4,37,423	2,42,101	1,95,322
1920-21	4,19,738	3,13,863	1,05,875
1921-22	3,58,423	3,40,883	17,540
1922-23	5,00,662	2,73,811	2,26,851
1923-24	5,03,180	1,60,101	3,43,079

The Profit and Loss Account shows that the cost of formation had been cleared by 1913, so that the above surplus is a clear profit to Government. The large expenditure in 1919—1922 was chiefly due to the installation of a 2-ft. gauge steam tramway. The fact that last year's is the largest profit yet recorded is also due to the tramway, which under the Forest Engineer's guidance has become an infinitely more efficient and economical proposition than the other methods of bullock carts and 14 in. gauge bullock tramway, though the latter, which was bought secondhand some 43 years ago, is still lingering with us in spite of annual depreciation calculations!

As the new plantations should have practically no cost of formation to debit to them in future years, owing to the revenue derived from temporary cultivation leases of the unplanted area, they should yield at least Rs. 30 profit per acre from the time they

come into full bearing. It is proposed to lay down steam tramways for Chichawatni and Daphar during the next few years and the cost of these should be very much less than for Changa Manga where the Department has had to buy its experience.

Like all the other foresters we tried to find "*a place in the sun*" at Wembley, but probably the best advertisement for the wood of the plains plantation was the case of Uberoi's sports goods in the Punjab section. The sports manufacturer's trade at Sialkot, started by Sirdar Gandha Singh Uberoi about 25 years ago, is now one of the most flourishing trades in the province. Its chief demand is for "green" mulberry logs from which they use the white sapwood for the ring of the tennis racquet. The dry log is used for hockey sticks and the innumerable stumps and posts required for games sets. The price obtained for mulberry, which was only a few years ago a despised weed, is now considerably higher than that of *shisham*, the *bakain* (*Melia Azedarach*) which is coming in more each year in Changa Manga, has been adopted by the local people for many of their requirements, but from an economic as well as a revenue producing point of view *shisham* still holds the premier place.

From this brief resume of recent developments it will be seen that the originators of our Punjab plantation work certainly did not over-estimate its value and that there is a tremendous future for this branch of forestry in all the new centres of canal development.

R. MACLAGAN GORRIE, I.F.S.

IMPERIAL FORESTRY INSTITUTE UNIVERSITY OF OXFORD.

Prospectus for 1924-25.

Scope of Work.—The work of the Institute will comprise (1) post-graduate training of probationers for the forest services and other qualified persons, (2) training of research officers in special subjects, and (3) provision of courses for selected officers already serving.

The Institute does not undertake to provide a general training in Forestry such as is given at Universities or other centres where this subject is taught.

*Admission of Students**.—Only persons falling within one or other of the following categories are eligible for admission to the Institute :—

(*a*) Those possessing a Degree in Forestry or a Diploma or equivalent certificate of having satisfactorily completed an approved course of training in Forestry, who have been selected as probationers for the higher branch of some forest service ;

(*b*) Graduates with honours in Science who desire to become specialists in some branch of work connected with Forestry ;

(*c*) Forest officers deputed by their Governments to attend courses with the view of bringing their professional knowledge up to date.

(*d*) Students of approved qualifications not included in the first three categories who are admitted on the recommendation of Overseas Governments.

(*e*) Students with a University training in Forestry who may wish to attend the Institute on their own account and at their own expense.

Applicants for admission should send their names, together with details of previous training and subjects which it is proposed to study, to the Director, Imperial Forestry Institute, Oxford.

Course of Study.—The course of study will normally extend over one academic year, beginning October, and will be made sufficiently elastic to serve the needs of individual students. In special cases a period of less than one year may be arranged.

The following general programme of work indicates the subjects which will be dealt with during the academic year 1924-25 :—

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*NOTE.—The rules regulating the admission of students are strictly enforced. Applications from forest officers in India, who may not be included in either of the categories *a*) to *e*), are likely to cause disappointment unless supported by recommendations from their Governments.

Michaelmas Term (8 weeks, October 10th to December 6th).

Silviculture—elementary; characters and requirements of forest trees of Western Europe. Forest Mensuration—elementary; measurement of trees and timber. Forest Botany—pathology (mycology). Forest Entomology—lectures and laboratory. Economics. Climatology. Forest Utilization—chiefly felling and conversion, and minor products. Surveying.

Christmas Vacation (December 7th to January 15th).

No regular tours. Special work arranged if required.

Hilary Term (8 weeks, January 16th to March 14th).

Silviculture—sowing, planting and tending operations (theoretical and practical), natural regeneration, silvicultural systems (lectures in preparation for Continental tours). Forest Mensuration—measurement of sample plots, preparation of yield tables. Forest Valuation. Structure and properties of wood. Forest Entomology—lectures and laboratory. Forest Utilization. Economics. Forest law. Engineering (drawing and construction).

Easter Vacation (March 15th to end of April).

Tours in Continental forests. Afforestation work in Great Britain.

Trinity Term (8 weeks, end of April to end of June).

Silviculture, tropical. Forest Mensuration—measurement of sample plots, preparation of yield tables. Forest Management, including working plans (theory). Forest Policy. Soils, including field work. Forest Botany—physiology of trees, systematic, ecology. Forest Entomology—field work. Engineering—drawing, surveying (field work, including road project).

Long Vacation (early July till about middle of September).

Tours in Continental forests. Preparation of forest working plans (field work and compilation).

Continental Tours.—These will be arranged in progressive order, preceded by special lectures on Continental systems during February and March. The Easter Vacation tour will be devoted to the simpler methods to be seen in France, while the Long Vacation will be occupied with more varied methods, as practised in Germany, Switzerland, and Austria. Officers on leave who

wish to revise their knowledge of Continental systems should arrange the date of their leave to fit in with the programme of Continental tours, and should give the Director at least one month's notice of their intention to join one of these tours.

Fees.—An inclusive fee of £75 will be charged for instruction at the Institute. If the course of studies extends over less than one year, the fees charged will be £25 per Term and £1 per week for tours in the Vacation. These fees will include all charges for instruction both at Oxford and on tour, as well as for the use of apparatus, materials, library, etc.; they will not include living and travelling expenses.

No fees will be charged to students deputed by the British Forestry Commission or the Colonial Office.

Expenses.—Living expenses at Oxford during Term are roughly estimated at from £3 10*s.* to £4 10*s.* a week. Expenses on the Continent vary considerably with locality and other factors but ordinarily living is, if anything, cheaper than in England.

Membership of the University.—Students of the Institute may, at their own discretion, become members of the University; particulars regarding admission, expenses, etc., are given in a pamphlet entitled *General Information Concerning Admission, Residence, etc.*, obtainable (post free 6½*d.*) at the Clarendon Press Depôt, High Street, Oxford.

GASOLENE SKIDDERS.

We have received from the Clyde Iron Works of Duluth, Minnesota, U. S. A., circulars dealing with the adaptation of the internal combustion engine to timber haulage. It has been a serious disadvantage in the existing types of steam skidding machines that they are all too cumbersome and heavy for work in India. Mr. McGifiert, the head of the Clyde Iron Works paid a visit to India a few years ago and set himself to devise hauling machinery better suited to our requirements.

Two distinct types of machinery are now available. The Clyde Gasolene Ground Skidder in three sizes, forty, fifty and seventy-five horse power, which may be mounted on wooden

skids on long-steel skids or on a crawler type of tractor. The second type consists of the Clyde Skidding Attachment for Fordson Tractors.

The 50 H. P. skidder uses seven to nine gallons of petrol per day. Its weight is 10,000 pounds, without skids and the price 3,165 dollars f. o. b., Duluth. The Clyde Fordson skidder has advantages in mobility being readily moved on wheels or by sliding along the surface of the ground. The weight with haul-back drum is 3,200 pounds and the price 750 dollars f. o. b., Duluth both exclusive of the Fordson Tractor.

The petrol engine has hitherto been considered insufficiently flexible for work of this nature and it will be interesting to see whether the above adaptations can stand up to the work as well as the unsympathetic treatment which all machinery in India is subjected to.

A few circulars as well as a copy of Mr. McGiffert's forwarding letter are available in the office of the Forest Economist, Dehra Dun.

Empire Forestry has decided to fix its name as *Empire Forestry Journal*, and has made the effect retrospective by issuing indices to volumes I and II under the new title. Apropos of this we are reminded that the adjectival use of the words "forest" and "forestry" appears to be accompanied by a certain measure of misapprehension in India.

In the last number of the Journal of the E. F. A. (Vol. III, No. 7, July 1924) the majority of papers has been provided by forest officers in Africa, *viz :*

Afforestation of the White Nile Mud Flats (with *Acacia arabica*), by W. A. Davie ; Forestry in Tanganyika, D. K. S. Grant ; Impressions of South African Forestry, by J. Sutherland ; The Forests of South Africa, by C. C. Robertson ; Fires in the Pencil Cedar Forests of Kenya Colony, by N. V. Brasnett ; and The Men of the Trees, by R. St. Barbe Baker.

From Asia are two papers: The Burma Selection System, by H. C. Walker and Forest Reconnaissance, by F. W. Foxworthy.

Canada has two papers on the Pulp and Paper Industry, by Edward Beck and the Output from Canadian Forests in 1922.

Forestry in New Zealand is described by F. W. Foster.

Articles of British origin deal with the Imperial Forestry Institute, Oxford, Empire Timbers at Wembley (J. S. Corbett) and the Functions of Agent and Broker.

We note that an *interesting* photograph of the carved teak-wood Buddhist shrine at the B. E. E. is erroneously described as "an exact reproduction of the Shwe Dagon pagoda," Rangoon.

REVIEWS.

COMMON NAMES FOR INSECT PESTS.

REVIEW : PRELIMINARY CHECK-LIST OF COMMON NAMES USED IN APPLIED ENTOMOLOGY, by H. Morstatt, *Supplementa Entomologica*, Nr. 10, 1924, Price 2 Marks.

It appears to have been necessary for systematic entomologists to take the first steps to produce an index to the common names used for insect pests in the literature of economic entom-

ology. The check-list prepared by Dr. H. Morstatt and issued as a special number of the journal of the *Deutsches Entomologisches Institute*, Berlin, gives an alphabetical index of 56 pages to the English, French, German and Dutch names with their Latin equivalents. Such an index is badly needed, for many economic entomologists have the annoying habit of referring in their articles only to the popular name of an insect pest by which it is usually unrecognisable in other parts of the world.

In its present form the check-list is admittedly incomplete and of temporary value, but it is anticipated that an early revision will be undertaken, and that its scope will be extended to include brief data on the distribution of the pest and the form of injury due to it. With later revisions the editor, Dr. W. Horn, suggests that it may take the form of a Catalogue with references to synonyms and important literature, but we venture to think that such an elaboration is unnecessary in view of the pest—catalogues now in course of preparation by the Bureau of Entomology, London, and the Association of Economic Entomologists in America.

Popular names for insect pests are the natural outcome of conditions in countries speaking European languages, but in the Orient it is doubtful if they are an advantage. In India an English "common name" is as much an innovation as the Latin generic and specific names of the insect. When it is realised that there are 20 or 30 species of *Xyleborus* all ranking as shot-hole borers of *sal*, there appears to be no reason why Latin terms should not be adopted for popular use in forestry.

C. F. C. B.

CORRESPONDENCE.

[NOTICE.—Correspondents who wish their letters to appear in a particular number of the *Indian Forester* should ensure that they reach the Honorary Editor *by the 15th* of the previous month. Unless exceptionally long they will be inserted.]

THE NORMAL SAL SELECTION FOREST.

SIR,—I have been attacked in various quarters for having the audacity to propound a theoretical conception of the normal *sal* selection forest.

Mr. Howard starts out to deny that the diameter class distribution in a selection forest is the same as that for a uniform forest. I, on the other hand, accept the statement, until the contrary has been proved, that the silvicultural system employed makes no material difference to the theoretical conception of the normal forest.

What is the normal forest? According to Recknagel "it is a standard with which to compare an actual forest to bring out its deficiencies for sustained yield management, a forest with normal age classes, in size and distribution, normal increment and normal growing stock." The conception of a normal forest is a mere ideal, it is non-existent under any system of management and any controversy about the nature of this ideal is not likely to end in anything tangible.

M. Gurnaud who advocated the adoption of the selection system in France was unable to furnish incontrovertible evidence concerning the normal stocking of the selection forest. He failed to establish that the normal stocking of the selection forest is higher than that of the uniform forest. Indeed, the modern Swiss School headed by Biolley has as yet made no pretentions to an exact knowledge of what the normal growing stock under the selection system should be.

All I have done is to draw the curve of what to the best of my ability I consider to be the normal distribution of the diameter classes, taking as a basis the figures of Howard's *sal* yield table and assuming that what I have said above is true, that in effect the normal stocking of the selection forest and the uniform forest are identical for all practical purposes. In other words it is supposed that every acre of the selection forest has its own share of trees ranging from the smallest to the largest, mixed anyhow so that each acre under selection contains $\frac{1}{r}$ of the trees of all dimensions which would otherwise have been on r acres, each acre having trees of the same age. It is immaterial whether the diameter classes are mixed on one acre or grouped in even-aged groups on 100 acres the results so far as the curve is concerned will be the same. It is admitted that the selection system affords

the possibility of a larger number of trees per acre than the uniform system, on the obvious mathematical conception that it is possible to pack in a unit of area more trees of crowns of different sizes in different planes than trees with crowns of the same size in one plane. The probability of this conception being true in practical forestry is unfortunately very remote. The factors that are responsible for growth, the productivity of the soil, the activity of light, and the supply of carbon dioxide, are practically constant for a unit of area. The claim that the supply of light and carbon dioxide is increased by having trees of different heights (*i.e.*, the selection forest) in a unit of area, is untenable; the vital factors of growth being constant, the chances of getting more trees in a unit of area under the selection system than under the uniform system are remote. The soil will be unable to support a number larger than the maximum (the normal).

In this conception I am in good company. Schlich states (page 227, Vol. III, Manual of Forestry): —

"The growing stock of a normal selection forest may be placed equal to that of a forest under the clear cutting system as all the age gradations are represented in a similar way though differently arranged over the area; hence it can be ascertained by summing up the quantities given in a yield table."

I will now proceed to show how the figures of the *sal* normal forest quality II have been obtained.

Taking the figures of Howard's *sal* yield table for even-aged forest of this quality, a curve can be drawn showing the relation between the age and the number of trees per acre (Curve 1, Plate 24). If the units on the age axis each represent one year, and those on the number of trees' axis each represent 5 trees, then the number of trees on one acre of uniform forest between the ages **A** and $\mathbf{A}_1$, will obviously be 5 times the number of squares between the age axis, the curve, and the verticals **A** and $\mathbf{A}_1$ or more accurately 5 times the number of square units of area within these 4 limiting lines. If a normal even-aged forest be considered with 1 acre under forest of each age up to the rotation age r, it follows that the total number of trees in the forest of

Plate 24.

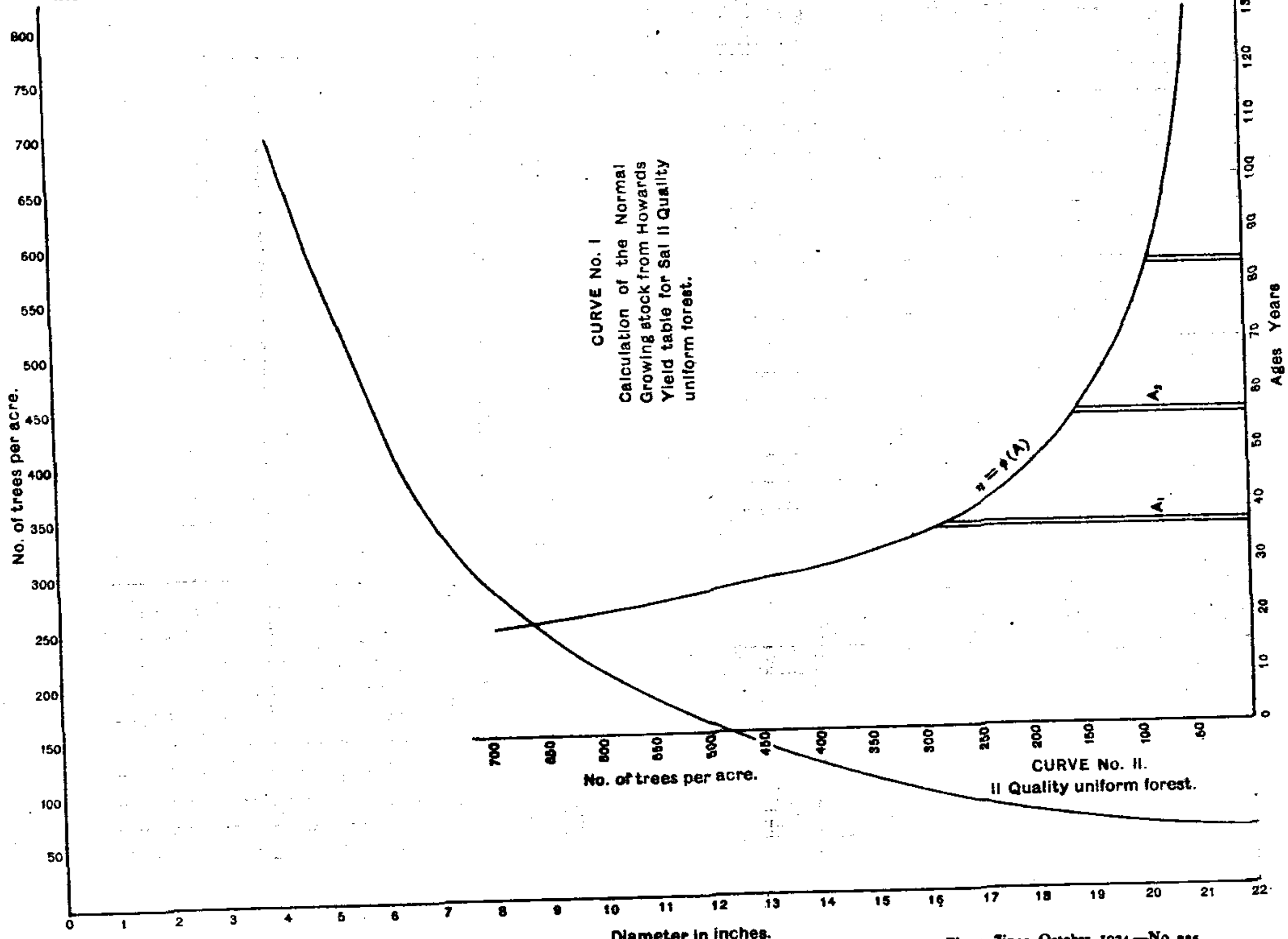


Photo. Zinco. October, 1924.—No. ...

acres, will be directly proportional to the area between the two axes of the curve, the curve itself, and the vertical at **r** and actually 5 times the number of square units.

Until it can be proved to the contrary, it is accepted that **r** acres of normal selection forest will have the same number of trees of each age, but completely intermingled equally in every acre.

Similarly the number **N** of trees in either of these normal forests between the ages $\mathbf{A}_1$ and $\mathbf{A}_2$ is proportional to the area between the verticals at $\mathbf{A}_1$ and $\mathbf{A}_2$. the age axis and the curve, which area can be obtained by planimeter or by counting up the squares, and they will occupy in each case an area of $\mathbf{A}_2-\mathbf{A}_1$ acres. If now $\mathbf{A}_1$ and $\mathbf{A}_2$ are the ages corresponding to the diameters $\mathbf{D}_1$ and $\mathbf{D}_2$ limiting a selected diameter class (these figures are available in the yield table), **N** will be the number of trees in this diameter class in $\mathbf{A}_2-\mathbf{A}_1$ acres of normal selection forest. In this way, points can be obtained permitting the drawing of a second curve (Curve 2, Plate 24) for the number of trees per acre against the diameter.

The number of trees of each diameter class per acre of normal selection forest can be taken direct from either of these curves in the way just described, and this is done for a rotation age **r** of 100 acres in the following table :—

Diameter class Inches.	Age in years.	Number of trees on 100 acres.	Number of trees per acre.
18—16	110—84	1,369	14
16—14	83—70	1,482	15
14—12	69—57	1,788	18
12—20	56—46	1,992	20
10—8	45—37	2,205	22
8—6	36—28	3,234	32
6—4 —	27—19	5,303	53
	Total ...	17,373	174

All this can be expressed in mathematical symbolism by the following equation, the result of integration between the limits A_1 and A_2 of the equation $n = \phi(A)$ connecting the number of trees per acre with the age of the (uniform) crop :—

$$N = {}^{A_1}_{A_2}\int \phi(A)\, dA$$

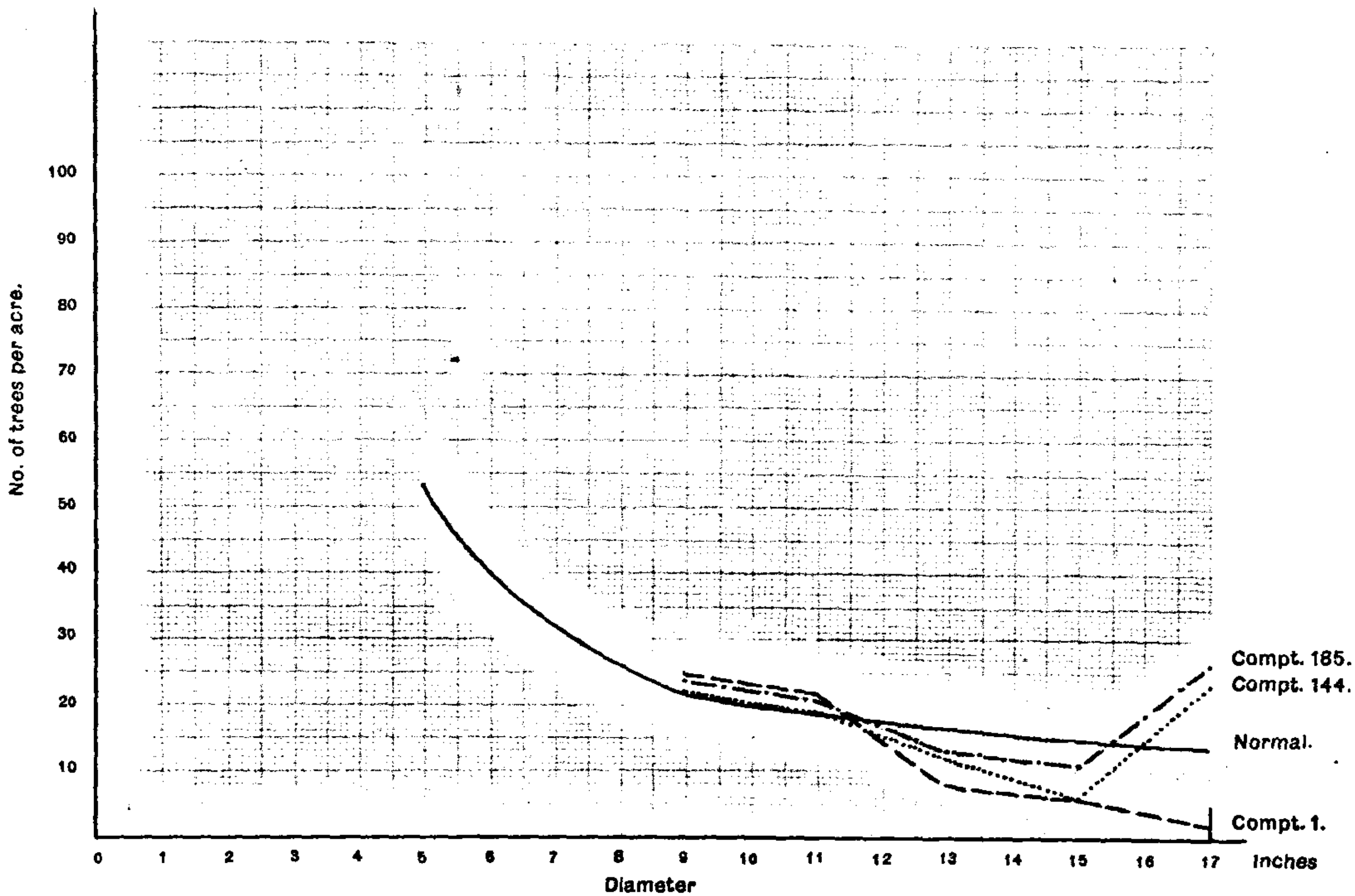
Incidentally there is an error in the published yield tables. In curve No. 7 the number of trees is wrongly entered and the mistake is perpetuated on page 22 where the number of trees at the age of 20 years is not 780 but 680.

So far I have dealt with the theory. I have constructed a theoretical normal standard curve with which to compare the actual growing stock. This is the only thing of any importance so we will now examine the facts disclosed.

The graph No. 3, Plate 25, shows the normal number of trees per acre for the diameter classes 4″—6″ ; 6″—8″ ; 8″—10″ ; 10″—12″ ; 12″—14″ ; 14″—16″ ; 16″—18″ at the arithmetical mean diameters 5″ ; 7″—11″ .....17″. This normal curve can be used as a standard for comparison of the actual growing stock of various compartments. For example, by plotting the curves for compartments 1,185,144 of North Kheri Division, it is clear that compartment 1 is in excess in diameter classes up to 12″ and is deficient from 12″ onwards. Similar conclusions can be drawn from compartments 144,185 and this is all that was ever intended and to anyone who has to mark a selection felling in any compartment such a graph cannot but be a useful guide in showing how the marking should bear on the various diameter classes if the object of marking is to obtain a selection forest approaching more nearly to the normal however hypothetical this may be.

Mr. Howard denies that my curve of the normal forest is of any practical utility so we will now investigate the description of these compartments prepared without any reference to this controversy.

No 3
THE STANDARD NORMAL CURVE
SAL SELECTION II QUALITY.



No.885-1.

Comptt No.	*Description of the growing stock.*	Quality class.
1	The crop is dense poles and saplings in which the saplings predominate, forming patches and strips throughout the area. Most of the older trees have now been removed and dense regeneration has come up in all blanks. There are a large number of young *asna* mixed with the *sal*, these two forming almost the entire crop.	II But as the crop as a whole is not mature the stand is generally below the minimum height of this Quality class.
144	The forest crop is confined to the north-eastern half of the compartment and is situated wholly on the high level. The crop is mixed *sal* and *asna* in the usual proportions. Both species are present in excess in the pole and sapling stage, but all classes are fairly well represented. Old and useless trees must be removed, even by departmental working as they are hampering the young crop, and it is to be feared that if girdled they will be attacked by ficus, and ultimately carry a denser crown than at present.	II
185	The crop is similar to that in compartment 176(*b*) but the congested pole crop gives way to a sapling crop in a similar stage of congestion along the north western boundary. The density of the crop is not so high in the western end	II
176(*b*)	The crop is generally similar to that in compartment 172(*d*) but as there is a slight undulation running across the compartment the *sal* in the depression is not so dense as on the slightly higher levels where it forms a fairly dense pole crop over most of the area. Older trees are more numerous in proportion to the younger age classes than generally found on the high ground.	II
172(*d*)	The crop is almost pure *sal*, *asna* being generally scarce and occupies almost one-half of the compartment, the remainder being open grass land. All age classes are present, but there is a preponderance of poles, more specially in the north.	II

I would now ask the reader to compare these descriptions with curve No. 3 showing how the growing stock in these compartments differs from what I have taken as the normal. It will be observed that the curves follow the descriptions very closely, that in C. 1 there is an absence of big trees and a dense pole crop, in C. 144 excess of young stock, fair representation of medium and again excess of old stock. In C. 185 all age classes

are represented with a preponderance of poles and older trees are more numerous than generally found. My normal curve therefore shows quite correctly the abnormalities of stocking disclosed in the description of compartments and I have no reason to be dissatisfied with it. It answers the purpose for which it is used and is of practical utility and this is all I require of it, whether it satisfies Mr. Howard or not is a matter of indifference to me.

C. G. TREVOR, I.F.S.